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The use of 2 techniques for teaching the laboratory phase of a driver education program is compared and analyzed with respect to the ethnic background (Mexican American and Anglo), socioeconomic status, and sex differences of the students. The final sample consisted of 269 students from 7 secondary schools in El Paso, Texas. The basic difference in the instructional methods used for comparison was the inclusion of a driver simulator in one method opposed to no simulator in the other method. The results of this study imply that there is no apparent difference in the quality of instruction between the teaching techniques, nor is there any advantage of one treatment over the other when applied to a specific population. (Author/DB)

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A STUDY OF THE EFFECTIVENESS OF TWO TEACHING TECHNIQUES IN DRIVER EDUCATION CONSIDERING ETHNICITY, SOCIOECONOMIC STATUS, AND SEX AS CONTRIBUTING SOURCES OF VARIATION

BY

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"A Study of the Effectiveness of Two Teaching Techniques in Driver Education Considering Ethnicity, Socioeconomic Status, and Sex As Contributing Sources of Variation," a dissertation written by Carroll Hall in partial fulfillment of the requirements for the degree Doctor of Education, has been approved and accepted by the following:

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VITA

David Carroll Hall, son of Everett and Oma Lee Hall, was born November 1, 1933, in Amarillo, Texas. He attended Alanreed and McLean, Texas, public schools and graduated from McLean High School in 1951.

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ABSTRACT

The purpose of this research study was to determine the relative effectiveness of two techniques for teaching the laboratory phase of a driver education program. The two techniques were:

1. An instructional treatment in which the student received six hours of on-street instruction behind the wheel, and six hours of in-car observation on public streets and highways.
2. An instructional treatment in which the student received twelve hours of instruction in a driver simulator, three hours of on-street instruction behind the wheel, and six hours of in-car observation on public streets and highways.

The fact that the population used for this study resided in a multi-cultural community and recognition that different cultures have unique problems associated with learning, led to the consideration of ethnic background, socioeconomic differences, and sex differences as possible contributing sources of variation.

Performance scores were obtained on each student included in the sample at the conclusion of the driver education course by administering the National Test in Driver Education for knowledge, the Siebrecht Attitude Scale for attitudes, and Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles for skill.

A multiple classification analysis of covariance was used to analyze the data using the students' composite score on the Iowa

Test of Educational Development as the covariate. The design of the study was such that not only could the effects of each variable (technique, ethnicity, socioeconomic status, and sex) be measured directly, but interactions in all possible combinations could be isolated.

Specific hypotheses to be tested were as follows:

1. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between students taught by a simulator centered course and students taught by a dual-control car centered course after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.
2. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between Mexican-American and Anglo-American students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.
3. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores

between male and female students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.

4. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between nondisadvantaged and disadvantaged students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.
5. There is no significant first-order interaction between method of instruction and sex, ethnicity, and/or socioeconomic status with respect to driving knowledge, attitude, and skill mean scores.
6. There is no significant first-order interaction among all possible combinations of sex, ethnicity, and socioeconomic status with respect to driving knowledge, attitude, and skill mean scores.

The findings of the study indicated that:

1. There was no significant difference in the mean scores of the students as measured by knowledge, attitude, and skill scores for any of the independent variables (method of instruction, ethnicity, socioeconomic status, or sex).

2. There was no significant interaction of the independent variables, with the exception of the treatment by socioeconomic combination for the attitude criterion. This interaction was found to be significant at the 0.05 level but not at the 0.01 level.

The results of this study imply that there is no apparent difference in the quality of instruction between the two teaching techniques, nor is there any advantage of one treatment over the other when applied to specific populations.

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

I. THE PROBLEM

In attempting to provide equal educational opportunities for all students, the school administrator must explore every possibility for improving educational opportunities. Utilization of most appropriate teaching techniques is one area in which improvement may be gained. Evaluation of the relative effectiveness of different teaching techniques in specific courses enables the administrator to more rationally choose the technique best suited for the population under study. The evaluation process should take into consideration the possibility of extraneous variables contributing to and/or interacting in such a manner as to obscure the true effects of the treatments under study.

Statement of the problem. It has been found that driver and traffic safety education courses can meet a special need of society and at the same time assist the secondary school systems in meeting their general objectives. It is believed that

> . . . effective driver education courses will develop the essential knowledge, correct habits, fundamental skills, proper attitudes and sound understanding necessary for the safe use of our highway transportation system.[1]

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[1]Association of Casualty and Surety Companies, Accident Prevention Department, What Everyone Should Know About High School Driver Education (New York: The Association, 1959), p. 3.

School administrators, when faced with a shortage of qualified instructors, increased operational costs, and tighter budgets, look toward innovative instructional techniques that will attempt to alleviate these problems and concurrently maintain quality instruction. Prior to adoption of any new technique, however, an exhaustive study must be made of the relative effectiveness of the proposed technique as compared with the technique currently in use.

This study was conducted to help determine if there were differences between two separate teaching methods presently used in the El Paso, Texas, Public School System for teaching the laboratory phase of the driver education program. Included in the evaluation was the determination of the effects of cultural, sociological, and sex differences when considered as possible factors contributing to variations in achievement.

Purpose of the study. The purpose of this study was to determine the relative effectiveness of a simulator centered teaching technique and a dual-control car centered teaching technique used in the laboratory phase of driver education programs as measured by knowledge, attitude, and skill scores. Ethnicity, sex, and socioeconomic status were considered as additional contributing sources of variation.

Objectives of the study. The major objective of this study was to determine if a simulator centered technique for teaching the laboratory phase of a driver education program was significantly

different from the traditional method currently in use in the El Paso Public Schools. In order to adequately evaluate the two methods, the following specific questions had to be answered:

1. Will the driving knowledge, attitudes, and skills of students taught by a simulator centered course differ significantly from the driving knowledge, attitudes, and skills of students taught by a dual-control car centered course?
2. Will the driving knowledge, attitudes, and skills of Mexican-American students differ significantly from the driving knowledge, attitudes, and skills of Anglo-American students?
3. Will the driving knowledge, attitudes, and skills of male students differ significantly from the driving knowledge, attitudes, and skills of female students?
4. Will the driving knowledge, attitudes, and skills of nondisadvantaged students differ significantly from the driving knowledge, attitudes, and skills of disadvantaged students?
5. Will the method of instruction indicate significant first-order interactions with sex, ethnicity, and/or socioeconomic status with respect to driving knowledge, attitudes, and skills?

6. Will sex, ethnicity, and socioeconomic status, in all combinations, indicate significant first-order interactions with respect to driving knowledge, attitudes, and skills?
7. Will the driving knowledge, attitudes, and skills of Mexican-American students taught by a simulator centered course in Spanish differ significantly from the driving knowledge, attitudes, and skills of Mexican-American students taught by a simulator centered course in English?

Assumptions. In the course of this investigation the following assumptions were made:

1. It was possible to identify the ethnicity of the student by a combination of surname, identification by the instructor, and response to a questionnaire.
2. The translation of the narration that accompanies the instructional films used in the driver simulator from English to Spanish was in a form and style fully understood by the sample to whom it was administered.
3. The socioeconomic classification of disadvantaged or nondisadvantaged could be determined by analysis of the records of the school counselor in conjunction with the judgment of the counselor.
4. The Iowa Test of Educational Development is a valid measure of student achievement, is highly correlated

with the dependent variables knowledge, attitudes, and skills, and is not affected by the treatment factors.

5. The National Test in Driver Education, the Seibrecht Attitude Scale, and Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles are valid measures of knowledge, attitudes, and skills respectively of the driving task.
6. The students enrolled in the driver education program for the spring semester, 1969, were representative of the students who will enroll in the course in the future.
7. The samples selected from Austin and Coronado high schools, although not "randomly" assigned to instructional methods, would not seriously depart from the assumption of random selection necessary for the analysis.

Limitations. This study was limited to the following secondary schools in the El Paso, Texas, Public School System: Austin, Bowie, Coronado, El Paso High, El Paso Technical, Irvin, and Jefferson. Any inferences drawn from the results of this study should be confined to the population from which the sample was taken and other populations with similar characteristics.

The possibility of differences in achievement due to differences in order of presentation of classroom instruction and the

laboratory phase is recognized as a limitation that could affect the results of the experiment. McIntosh found, however, that order of presentation does not significantly affect performance in high school driver education courses.[2]

II. DEFINITIONS OF TERMS

The following definitions are applicable to this study:

Driver education. This term refers only to those aspects of driver and traffic safety education formally taught as a regular part of the scheduled driver education classes. This consists of two parts--classroom instruction and a laboratory phase for practice driving.

Classroom instruction. This refers to that part of the driver education program that is conducted in the high school classroom. Instruction covers such content areas as characteristics of drivers, traffic citizenship, laws and regulations, physical laws, and use of the automobile.

Laboratory phase. This refers to that part of the driver education program in which the student receives training in real and/or simulated automobiles. This phase of the course is designed to develop skill in the manipulation of an automobile, as well as

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[2]Edward Roy McIntosh, "A Study of the Efficiency and Effectiveness of Four Different Modes of Instruction in Providing Learning Experiences for High School Driver Education Students" (unpublished Doctoral dissertation, Michigan State University, East Lansing, 1967), p. 90.

to increase the student's knowledge and develop proper attitudes toward traffic safety.

Driving simulator. This is an electro-mechanical device designed to represent the driver's side of an automobile. The student operates the device as he would a real car, reacting to varying traffic situations that are projected on a screen at the front of the classroom by means of full-color motion pictures complete with sound.

Dual-control car centered course. This refers to an instructional treatment consisting of (1) thirty hours of classroom instruction, and (2) six hours of on-street instruction behind-the-wheel, plus six hours of in-car observation.

Simulator centered course. This instructional treatment consists of (1) thirty hours of classroom instruction; (2) twelve hours of instruction in a driver simulator; and (3) three hours of on-street instruction behind-the-wheel, plus six hours of in-car observation.

Treatment I. This refers to the laboratory phase only of the dual-control car centered course in the teaching of driver education.

Treatment II. This refers to the laboratory phase only of the simulator centered course in the teaching of driver education.

Treatment III. This refers to the laboratory phase of the simulator centered course that has been modified to the extent that the narration accompanying the instructional films used in conjunction with the simulator has been translated into Spanish.

Disadvantaged. This term refers to those students from families whose combined annual income does not exceed $3,000.[3]

Nondisadvantaged. This refers to those students who do not meet the criteria for classification disadvantaged as defined previously.

III. ORGANIZATION OF THE STUDY

Chapter II contains a review of related literature and research. Chapter III consists of the design of the study, hypotheses to be tested, description of the treatments administered, methods of sampling, measuring instruments and the statistical treatment applied to the data. The findings of the study, including presentation and analysis, are presented in Chapter IV. Chapter V contains a summary of the study, interpretations and conclusions drawn from the analyses, and recommendations for further research.

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[3]John F. Hughes (director), Title I Program Guide No. 36, United States Department of Health, Education and Welfare, Division of Compensatory Education (Washington: Government Printing Office 1968), p. 2.

CHAPTER II

REVIEW OF LITERATURE

This chapter is divided into two sections. The first section is concerned with the results of previous research and a rationale for conducting the study. Section two justifies the consideration of additional variables as possible contributing sources of variation.

I. RESULTS OF RELATED RESEARCH

Numerous studies to investigate the usefulness of driver instruction have been carried on by schools, universities, insurance companies, and traffic enforcement agencies. Evidence contained in a report by the National Commission on Safety Education emphasized the extreme difficulty of scientifically measuring so complex and complicated a phenomenon as driving behavior. It did point out, however, that indulging in a traffic safety program does reduce accidents.[1] Results of a study by Doss indicated that students who take driver education are more informed about driving practices and principles and seem to possess a more favorable attitude toward safe driving practices.[2] The most convincing proof of

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[1]National Commission on Safety Education, A Critical Analysis of Driver Education Research (Washington: National Education Association, 1957), p. 56.

[2]James Karl Doss, "A Study of the Value of Driver Education" (unpublished Doctoral dissertation, Oklahoma State University, Stillwater, 1964).

the effectiveness of driver education programs has come from the insurance companies, most of which grant discounts to drivers, fifteen to twenty years old, who have passed a driver education course meeting national standards.[3]

School systems, in which driver education has been accepted as meeting a special need of the student while assisting in attaining the overall general objectives of the school, are faced with many problems. Increased enrollment, shortage of qualified instructors, high per-pupil cost of instruction, scheduling difficulties, and individual differences in student characteristics, have forced the school administrator to seek new solutions to alleviate these problems and still provide assurance of quality instruction in the area of driver education.

The "one-car-one-teacher" approach in the traditional laboratory phase of the driver education program has proved to be successful in small schools and in larger schools with limited enrollment, but has intensified the previously stated problems in schools in which the demand for participation in the course exceeds the capabilities of the school system. As a result, school administrators are considering the use of different teaching techniques, such as driver simulators, as solutions to the problems associated with the laboratory phase.

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[3]Paul W. Kearney, Why Driver Education Is a Must (Reader's Digest reprint, "Why Driver Education Is a Must," October, 1964, from Parents' Magazine. Pleasantville, New York: Reader's Digest Association, Inc., 1964).

Simulation is a technique for studying and actively participating in complex, real-life phenomena in a controlled environment. The technique consists of designing a representative model of the subject of interest, manipulating various aspects and variables of the model according to some predetermined plan, and evaluating the outcome according to predetermined criteria. A basic assumption is that the knowledge and experience gained will be applicable to the real-life situation.

The driver education simulator is an electro-mechanical device, designed to represent as closely as possible the driver's side of an automobile. This device provides practice situations under test conditions which can be used to develop among students those abilities that are considered essential to safe and responsible driving. In principle these devices are similar to those used to train pilots and more recently those used to train astronauts. The student operates the device just as he would a real car on the highway. Realistic traffic situations are projected on a wide screen film and the student's reactions to these situations are electronically measured and evaluated. Manual skills can be taught without films such as starting the engine, shifting gears, and so forth. These simulator units can either be placed in a classroom or in a van to be transported from school to school.

The value of film demonstration as an auxiliary teaching device has been well documented. Allen, in reviewing film research, concluded that learner participation during a film and immediate

knowledge of results facilitate learning.[4] Fletcher, in a study concerning the effectiveness of film demonstrations, concluded that film demonstration could be substituted for the live demonstration in the development of driving skills without disadvantage to the student.[5]

It should be emphasized that the simulator-based method of instruction in driver education is an integrated course. Both verbal and nonverbal means of communication are utilized. Certain kinds of devices are more effective than others in teaching certain subject matter under certain conditions. For example, the Educational Policies Commission pointed out that film was frequently better for teaching material that involved demonstrations, while printed or verbal descriptions were more efficient for presenting concepts.[6] A logical conclusion is that a variety of methods may be more effective than a single method.

Several advantages have been stated as being the direct result of utilizing synthetic training devices in driver education.[7]

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[4]William H. Allen, "Audio-Visual Communication," Encyclopedia of Educational Research (3rd ed. New York: The Macmillan Company, 1960), p. 125.

[5]Harry David Fletcher, "Instruction by Film Demonstrations and Live Demonstrations in the Teaching of Selected Automobile Driving Skills" (unpublished Doctoral dissertation, Pennsylvania State University, University Park, 1965).

[6]Educational Policies Commission, Mass Communication and Education (Washington: National Education Association, 1958), p. 91.

[7]James H. Fox, Driver Education and Driving Simulators, National Commission of Safety Education, National Education Association (Washington: National Education Association, 1960), p. 1.

Among these are:

1. A larger number of students can receive the benefits of the program than is possible when the devices are not used.
2. The per-pupil cost of instruction can be substantially reduced.
3. Fewer teachers are needed.
4. Students can learn the necessary complex skills as effectively as in the dual-control car.
5. Students can develop better attitudes.
6. Students can learn appropriate responses to emergency situations without the attendant hazards of actually being in a car on the road.
7. Electric scoring devices can provide for the immediate detection of student errors by the teacher.

Boyer concluded that the greatest value of a simulator is that it is a catalyst to both classroom instruction and practice driving. It offers the student the opportunity to analyze, practice, and interpret.[8]

Perhaps the most appealing aspect of utilizing simulation techniques in the training of driver education classes is the reduction in per-pupil cost of the laboratory phase of the program. Many claims have been made of tremendous savings when

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[8]Richard Boyer, "Simulator Presents, Student Responds, and Instructor Evaluates," Traffic Digest and Review (reprint. Evanstan, Illinois: Northwestern University, February, 1964).

utilizing simulators, but in a given school system there are many factors which determine the actual cost. Differences in teacher salaries, insurance rates, leasing arrangements for equipment, capacity of equipment, etc. are all factors that contribute to the cost of the overall program. Studies conducted at Cedar Falls, Iowa,[9] Los Angeles, California,[10] Houston, Texas,[11] and El Paso, Texas,[12] all indicate significant savings but varying in the per-pupil amount.

The reported advantages of utilizing simulation as a training technique have not led to universal acceptance at this time. More research is needed concerning the quality of this instructional device.

Previous research has considered, for the most part, only the evaluation of the treatments under study with very little effort made to control for other possible sources of variation. Many of

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[9]Gordon J. Rhum, Bertram J. Woodcock, and Tom A. Lamke, The Effectiveness of the Aetna Drivotrainer in Driver Education (Cedar Falls, Iowa: Iowa State Teachers College, July, 1956).

[10]Los Angeles City Schools, An Evaluation of the Teaching Effectiveness of the Aetna Drivotrainer (Los Angeles: Los Angeles City Schools, 1955).

[11]Everett J. Lanik, "Cost Analysis of Driver Education Programs Conducted in the Houston Independent School District for the School Year 1967-1968, Summer 1968" (Houston, Texas: Houston Independent School District, 1968). (Mimeographed.)

[12]David C. Hall, "A Cost Analysis of a Driver Education Program" (paper prepared for the Region XIX Education Service Center, El Paso, Texas, February, 1969).

these studies have resulted in "no significant differences found in treatment means."

When substituting nine hours on the simulator for three hours behind-the-wheel instruction, Curtis found no significant differences between performances, as measured by knowledge, skill, and attitude, of the experimental group and a similar group receiving the traditional six hours behind the wheel.[13] Two studies conducted at Michigan State University were of a slightly different design. Gustafson compared the effectiveness of a program using a simulator plus the range with a program utilizing the range alone.[14] Nolan compared the teaching effectiveness of the multiple-car range with that of the simulator.[15] While each drew a number of conclusions, in general the differences in the performance of the groups were not significant.

Bishop, in substituting twelve hours of simulator training for three of the six hours behind the wheel, found a significant increase in driving knowledge in favor of the simulator, but no significant differences in attitude scores or skill scores. He

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[13]Carroll A. Curtis and Robert B. Hayes, "Immediate Learning Reinforcement in a Complex Mental-Motor Skill," Driver Training Using Motion Pictures, Phase III (final report. Harrisburg, Pennsylvania: Department of Public Instruction, March, 1967).

[14]Robert E. Gustafson, "A Study to Compare the Effectiveness of Instruction in the Allstate Good Driver Trainer and in the Multiple-Car Off-Street Driving Range "(unpublished Doctoral dissertation, Michigan State University, East Lansing, 1965).

[15]R. O. Nolan, "A Comparative Study of the Teaching Effectiveness of the Multiple-Car Off-Street Range and the Aetna Drivotrainer" (unpublished Doctoral dissertation, Michigan State University, East Lansing, 1965).

concluded that the simulator centered course compared favorably with the traditional course.[16]

In 1966, Seals reported significant differences were found when comparing a four-phase program consisting of classroom instruction, simulation, driving range, and in-car experience with a similar program excluding the simulation phase.[17] Significant differences were also detected by Board in a longitudinal study conducted in the Houston Independent School District in which comparisons were made between the traditional program and a program composed of thirty hours classroom instruction, twelve hours simulation, and three hours behind the wheel.[18]

The conclusion of "no significant differences" found in most studies prior to 1966 may be explained by the lack of control in the experimental design, or the instruments used for testing these differences may have been too weak to properly identify existing differences. It is interesting to note that as the designs become

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[16]Richard W. Bishop, Evaluating Simulator Instruction for Accomplishing Driver Education Objectives (Tallahassee, Florida: Florida Institute for Continuing University Studies, 1963).

[17]Thomas A. Seals, "An Evaluation of Selected Driver and Traffic Safety Education Courses" (unpublished Doctoral dissertation, Florida State University, Tallahassee, 1966).

[18]Donald M. Board, "Fall Term, 1965-1966" (Report No. 1 of Driver Education Research Project, Houston Independent School District, 1966); "Final Report of Instructional Program" (Report No. 2 of Driver Education Research Project, Houston Independent School District, 1966); and "Driver Performance Analysis" (Report No. 3 of Driver Education Research Project, Houston Independent School District, 1967).

more sophisticated, more significant relationships are noted that tend to show strengths and weaknesses in specific component-areas of the driving task. As more variables are identified and controlled in analyzing the performance, a better judgment can be made by the administrator as to where and what form of instruction will produce results commensurate with the objectives of the program. A note of caution was injected by Bishop, however, when he stated:

> The potential of simulator instruction with respect to knowledge and skill (including perceptual skill and judgment) appears highly promising. The word "potential" is emphasized since regardless of teaching method, the teacher is still the key to effectiveness. This statement applies to either simulator or behind-the-wheel instruction.[19]

II. POTENTIAL SOURCES OF VARIATION

The fact that the population used for this study resided in a multi-cultural community and the recognition that different cultures have unique problems associated with learning led to the consideration of other variables as sources of variation in this evaluation. Ethnic background, socioeconomic differences, and sex differences which have been shown to be correlated with achievement were considered as possible additional sources of variation. It is understood that the possibility exists of other variables affecting performance, but it was felt that these three were the most relevant to the problem at hand.

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[19]Bishop, op. cit., p. 14.

Ethnicity As a Source of Variation

Administrative decisions to include, omit, or modify innovative instructional techniques in school systems in which a diverse ethnic school population is enrolled are often complicated by the fact that the assessment of such techniques does not take problems inherent with ethnic minority groups into consideration. Differences in language ability, economic level, and cultural values tend to intensify the problem of communication.[20] It has been suggested by the Educational Policies Commission of the National Education Association that educational programs that are specifically directed at better use of communication techniques could sharply improve the total intellectual growth of the student.[21]

Upshur alluded to the need for developing measures of non-linguistic communication and interaction and the need for a theory of the processes underlying effective communication in a foreign culture. However, any teaching materials must be presented within an educational pattern familiar or at least understandable to the reader, while employing verbal or visual devices necessary to make comprehensible the concepts selected for teaching. The illustrations, examples, and vocabulary utilized must be understood in

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[20]Hershel T. Manuel, Spanish-Speaking Children of the Southwest (Austin: University of Texas Press, 1965), p. 187.

[21]Educational Policies Commission, Mass Communication and Education (Washington: National Education Association, 1958), p. 85.

the student's real experience. The implication is that learning becomes a meaningful experience only when communication, both verbal and nonverbal, is complete.[22]

Of the minority ethnic groups in the United States, one of the largest is the Spanish-speaking group, with approximately 80 per cent residing in the Southwest.[23] Although points of origin are distinctly different for the Mexican-American and Spanish-American, these are considered as one category. A similarity of language and culture permits a generalization despite the tendency to overgeneralize either the educational program or the Mexican-American. Attention must be focused on specific programs for specific groups of Mexican-Americans because the wide range of residency in the United States and the diversity in acculturation result in great differences in the value systems of specific groups.

In 1965 the National Education Association Survey Team found that "the most acute educational problem in the Southwest is that which involves Mexican-American children."[24] The survey included

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[22]J. A. Upshur, "Cross-Cultural Testing--What to Test," Language Learning, A Journal of Applied Linguistics, 16(3-4):183, 1966.

[23]James G. Anderson and William H. Johnson, "Sociocultural Determinates of Achievement Among Mexican-American Students" (An Interim Report of the Mathematics Education Program Prepared for the National Conference of Educational Opportunities for Mexican-Americans. Austin, Texas, April 25-26, 1968), p. 1.

[24]National Education Association, The Invisible Minority (Report of the NEA Tucson Survey on the Teaching of Spanish to the Spanish-Speaking. Washington: National Education Association, 1966), p. 5.

approximately 1.75 million children with Spanish surnames in the elementary and secondary schools of five states. Since Mexican-Americans, like most minority groups, tend to live in clusters, it is not uncommon to find schools which are predominately of one ethnic background, especially noticeable in border towns and cities, such as El Paso, Texas.[25] Recognition of the problems associated with the education of these children has resulted in teachers' workshops, institutes, and special local programs.[26]

It is apparent that an educational gap does exist between Mexican-Americans and Anglo-Americans, especially at the high school level, according to Grebler. He reported that some progress has been made in decreasing this gap at the lower levels, but that the gap becomes increasingly wider at secondary levels.[27] Children enter school and immediately encounter a language barrier; they spend all their efforts learning the language rather than the subject matter; they have no dominant cultural values; and their vocabulary is small and localized.[28] Coleman found that the Mexican-American performs consistently lower in both verbal

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[25]Anderson and Johnson, loc. cit.

[26]National Education Association, op. cit., p. 26.

[27]Leo Grebler, The Schooling Gap: Signs of Progress (Advance Report No. 7 of the Mexican-American Study Project, Graduate School of Business Administration, University of California, Los Angeles, 1967).

[28]Dr. John M. Sharp, Professor of Modern Languages at the University of Texas at El Paso, personal interview, May, 1969, at the University of Texas at El Paso.

and nonverbal scores than the Anglo-American and that the difference is greater at grade twelve than at the first grade, thus supporting Grebler's thesis that the educational gap increases by levels.[29]

Use of simulator instruction in driver and safety education has been subject to considerable investigation.[30] It appears, however, that information is lacking on the effect of this particular instructional technique on students from a minority ethnic background. New methods of instruction, including driver education simulator techniques, are, of course, not confined to utilization by a single cultural or ethnic group; this has been the case in the past and will continue so in the future. Yet, by focusing upon possible differences between Mexican-American and Anglo-American student performances in driver education programs, this study may provide educators with insights and information that will permit decisions to be made about the initiation and modification of differing teaching techniques in a more rational manner.

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[29]James S. Coleman et al., Equality of Educational Opportunity, United States Department of Health, Education and Welfare (Washington: Government Printing Office, 1966), p. 20.

[30]James H. Fox, Driver Education and Driving Simulators, National Commission of Safety Education, National Education Association (Washington: National Education Association, 1960); David C. Hall, "A Cost Analysis of a Driver Education Program" (paper prepared for the Region XIX Education Service Center, El Paso, Texas, February, 1969); Richard W. Bishop, Evaluating Simulator Instruction for Accomplishing Driver Education Objectives (Tallahassee: Florida Institute for Continuing University Studies, 1963); and Thomas A. Seals, "An Evaluation of Selected Driver and Traffic Safety Education Courses" (unpublished Doctoral dissertation, Florida State University, Tallahassee, 1966).

Socioeconomic Status As a Source of Variation

Differences in socioeconomic status have long been known to contribute to variability in academic performance. Studies by Noll,[31] Knief and Stroud,[32] and Friedhoff[33] have all shown socioeconomic status to be directly related to academic performance. Lavin stated, "SES is a significant variable in the study of performance because it summarizes systematic variations in attitudes, motivations, and value systems that are related to such performance."[34]

Students from different socioeconomic backgrounds face different kinds of life situations and may develop different attitudes and values toward curriculum offerings. For example, their attitude toward the use of an automobile in the home situation may affect motives for achievement in the driving task.

Little research has been done considering socioeconomic status as a contributing variable in driver education achievement. Mariani found no significant relationships between driver education

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[31]Victor H. Noll, "Relation of Scores on Davis-Eells Games to Socioeconomic Status, Intelligence Test Results, and School Achievement," Educational and Psychological Measurement, 20(1): 119-29, 1960.

[32]Lotus M. Knief and James B. Stroud, "Intercorrelations Among Various Intelligence, Achievement and Social Class Scores," Journal of Educational Psychology, 50(3):117-20, 1959.

[33]W. H. Friedhoff, "Relationships Among Various Measures of Socioeconomic Status, Social Class Identification, Intelligence and School Achievement," Dissertation Abstracts, 15:2098, 1955.

[34]David E. Lavin, The Prediction of Academic Performance (New York: Russell Sage Foundation, 1965), p. 128.

performance and home location--a measure of socioeconomic status.[35] Gutshall showed that socioeconomic status is useful in predicting the habits of future drivers. In this study it was found that socioeconomic status tended to predict the number of violations a person would receive for speeding.[36]

These studies do not, however, consider the effect of socioeconomic status when interacting with other variables, such as different methods of instruction, ethnicity, and sex. The present study was designed to investigate these relationships.

Sex As a Source of Variation

There is a significant amount of reliable research about sex differences, as they affect one's learning and achievement, available to the educator.[37] Grambs and Waltjen, in reviewing this research, stated: "It makes a significant difference whether the person we are teaching is a boy pupil or a girl pupil and . . . instructional provisions should be made accordingly."[38]

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[35]Thomas J. Mariani, "The Effectiveness of Three Methods of Practice Driving Instruction in Driver Education," Dissertation Abstracts, 25:3439, 1965.

[36]Robert William Gutshall, "An Exploratory Study of the Interrelations Among Driving Ability, Driving Exposure and Socioeconomic Status of Low, Average and High Intelligence Males" (unpublished Doctoral dissertation, Michigan State University, East Lansing, 1967).

[37]Eleanor Maccoby (ed.), The Development of Sex Differences (Stanford, California: Stanford University Press, 1966), pp. 25-55.

[38]Jean D. Grambs and Walter B. Waltjen, "Being Equally Different: A New Right for Boys and Girls," National Elementary Principal, 46(2):60, November, 1966.

Studies conducted on performance in driver education programs between boys and girls are not conclusive. Board found that boys outperformed girls in all areas of the driving task.[39] Nolan found that boys outperformed girls in knowledge and skills but that there was no difference in attitudes.[40]

Rhum, Woodcock, and Lamke found, however, that performance on the test instruments for measuring knowledge, attitudes, and skills was not related to sex. They did indicate that additional research should be made before their findings could be generalized.[41] Lamkin implied that the need exists for greater understanding of the nature of sex differences.[42]

Interviews by this investigator with driver education instructors in the El Paso Public School System revealed that in their opinion female Mexican-Americans were superior to male Mexican-Americans in driving skills after training. This would indicate

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[39]Donald M. Board, "Final Report of Instructional Program" (Report No. 2 of Driver Education Research Project, Houston Independent School District, 1966), pp. 3-4.

[40]R. O. Nolan, "A Comparative Study of the Teaching Effectiveness of the Multiple-Car Off-Street Range and the Aetna Drivotrainer" (unpublished Doctoral dissertation, Michigan State University, East Lansing, 1965), p. 109.

[41]Gordon J. Rhum, Bertram J. Woodcock, and Tom A. Lamke, The Effectiveness of the Aetna Drivotrainer in Driver Education (Cedar Falls, Iowa: Iowa State Teachers College, July, 1956), p. 17.

[42]F. D. Lamkin, "A Personality Variable of Pre-adolescent Youth in Relation to the Elementary School Program" (Final Report, Virginia University, Charlottesville, School of Education, 1967), p. 3.

that more research is needed concerning the effect of sex in driver education programs when correlated with the ethnicity of the student.

This study was designed to determine if sex differences do in fact contribute to achievement performance variability within the population under study for the psycho-motor task of driving.

III. SUMMARY

The need for evaluating different teaching techniques in the area of driver education in order to decrease costs, increase efficiency, and maintain quality instruction is quite clear. The possibility that extraneous variables such as ethnicity, socioeconomic status, and sex may seriously affect the evaluation process has been mentioned. The design of this study was such that not only could the effects of each variable be measured directly but interactions in all possible combinations of the variables could be isolated. This study was also unique in that the statistical approach controlled for initial differences statistically rather than experimentally. An actual classroom was the setting for the study. By combining the results of this study with previous research, administrators in school systems with similar characteristics will have a more rational basis to make decisions upon in selecting and/or modifying driver education curricula.

CHAPTER III

DESIGN OF THE STUDY

The purpose of this study was to compare the relative effectiveness of differing techniques for teaching the laboratory phase of a driver education program. In this chapter are described the treatments used, hypotheses to be tested, instruments used to obtain data, the sample, procedures used in collecting the data, and the statistical tools utilized in analyzing the data.

I. THE TREATMENTS

This study was based upon a comparison of an experimental program for teaching the laboratory phase of a driver education program conducted by the Region XIX Education Service Center, El Paso, Texas, in cooperation with the El Paso Public School Officials and a traditional approach to teaching the laboratory phase conducted by the regular school staff. The approaches differed in that one utilized an automated innovation which altered the amount of time spent with the student by the instructor on a one-to-one basis. These programs are described below.

Treatment I was the traditional approach which has been referred to as the "dual-control car centered course." As stated previously, the laboratory phase is designed to develop skill in the manipulation of an automobile, as well as to increase the student's knowledge and develop proper attitudes towards traffic safety. Standards for

an approved Course in Driver Education, following the traditional approach, consist of the following:

> . . . Thirty clock hours of classroom instruction in addition to laboratory experience consisting of: six clock hours of in-car instruction on public streets and highways, and six clock hours in-car observation on public streets and highways.[1]

Treatment II was the experimental program conducted by the Region XIX Education Service Center, El Paso, Texas. Under a grant from the Texas Education Agency, the Center purchased a 16-place Link Driving Simulator housed in a mobile trailer. The simulator was operated by staff from the Service Center and was moved from school to school as the schedule permitted. Utilization of simulation equipment in the teaching of the laboratory phase of driver education programs has been approved by the Texas State Board of Education. Specific guidelines for curricular offerings are outlined in Standards for an Approved Course in Driver Education for Texas Schools. These are:

> . . . Thirty clock hours of classroom instruction in addition to laboratory experience consisting of: twelve clock hours of in-car instruction, and six clock hours of in-car observation. (Simulator systems must meet the specifications for "State of Texas Automobile Simulator and Trailer Specifications.")[2]

Treatment III was to have been an extension of treatment II in that a comparison was to be made between two differing methods

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[1]Texas Education Agency, Standards for an Approved Course in Driver Education for Texas Schools (Bulletin 615. Austin: The Agency, 1961), p. 2.

[2]Ibid., p. 4.

of teaching the laboratory phase of the driver education program, both utilizing the driving simulator with one major difference. One class was to receive instruction with the instructional films that are used with the simulator having been translated into Spanish, the other group receiving the instruction in English. The translation was made by a simulator instructor on the Education Service Center staff. The staff member was a native of El Paso and consequently the translation was in a form understandable to the sample under study. This treatment was applied to a sample of students from two high schools, the majority of whom were Spanish-speaking. Some difficulty was experienced early in the program in that the instructor using the Spanish version of the films felt that the students were not benefiting from the instruction as they should due to the inability of some to hear the translation. This problem was alleviated somewhat by rearranging the speakers in the simulator van. A check by this writer some two weeks later revealed that the instructor had reverted to the English version the week after rearranging the speakers. In the instructor's opinion, the students were still having difficulty in understanding the narration because of the quality of the equipment. There was no alternative but to discard this phase of the study. This would indicate that, if a further study were to be made using this approach, the translation should be accomplished in a more professional manner and pilot tested before implementation.

II. TESTING INSTRUMENTS

Effective driver education courses are believed to be useful for developing the essential knowledge, fundamental skills, and proper attitudes necessary for the safe use of automobiles on the streets and highways. The selection of instruments to measure performance in each of these component areas is of utmost importance. The selection of instruments for this study was based on the findings of Long.[3] This study was designed to select the instruments most applicable to driver education programs in the state of Texas. Validity, reliability, objectivity, areas of competencies, time needed to administer the test, and the feasibility of administering the tests were among the factors considered before recommending specific tests. Recommended tests were National Test in Driver Education[4] to evaluate student competencies regarding knowledge; Siebrecht Attitude Scale[5] for evaluating student competencies regarding attitudes; Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles[6] to evaluate competencies regarding driving skills.

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[3]Teresa Lozano Long, "Development of Instruments for the Evaluation of Driver Education" (unpublished Doctoral dissertation, University of Texas, Austin, 1965).

[4]Center for Safety Education, National Test in Driver Education (New York: New York University, 1963).

[5]E. B. Siebrecht, Siebrecht Attitude Scale (New York: Center for Safety Education, New York University, 1941).

[6]Amos E. Neyhart, Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles (Washington: American Automobile Association, 1961).

National Test in Driver Education. This standardized knowledge test consists of sixty items divided into two parts. Part I contains thirty-five true-false statements while Part II has twenty-five multiple choice statements. The test is designed to measure knowledge and information about safe driving practices, traffic signs, rules of the road, and other aspects of driver education and traffic safety. Each question is assumed to be equally weighted. Scoring is accomplished by totaling the number of correct responses.

Siebrecht Attitude Scale. This scale was developed in 1941 at New York University as a doctoral dissertation and is still the most widely used of the attitude scales in the area of driver education. The scale contains forty items, each a complete statement about specific factors considered to be important in safe driving. These factors are: (1) passing on curves and hills, (2) driving as a privilege, (3) enforcement of traffic regulations, (4) condition of the automobile, (5) responsibility, (6) speeding, (7) cooperation, (8) examination for drivers' licenses, (9) violations, (10) condition of drivers (11) courtesy, concern, and (12) knowledge and skills.[7] The individual indicates his reaction toward the statement in terms of a five-point scale ranging from "strongly agree" to "strongly dis-agree." There are no right or wrong answers as such.

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[7]Center for Safety Education, Revised Scoring Method for the Siebrecht Attitude Scale (New York: Division of General Education, New York University, 1958), p. 2.

The scale is scored by summing the values of the positions checked. Values from one to five have been assigned the positions for each of the statements.

A standard score was obtained from the standard responses of one hundred twenty-five traffic experts.[8] A standard score amounts to 173 points. By the split-half method a coefficient of reliability of .81 has been secured on a group of 100 students enrolled in driver-training courses. The validity of the scale rests upon the following bases:

> 1. The judgments of experts in traffic safety and attitude measurement were utilized to determine the factors which were believed to be important in the safe driving of the automobile and to evaluate the statement of opinion which comprised the preliminary form of the scale.
>
> 2. In the final form of the scale have been included only those statements which differentiated significantly between the mean scores of high- and low-scoring groups of students; a 20 per cent segment of the extremes was used. For none of the statements is the critical ratio of the difference between the means of the 20 per cent segments less than 3.00. The average ratio is 6.234.
>
> 3. The scale seems actually to differentiate between groups presumed to possess a difference of attitude toward the issue of safe driving. The greatest differences occur between the groups presumed to possess the greatest difference in attitude . . . .[9]

Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles. This standardized skill test was developed by

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[8]Ibid., p. 3.

[9]New York University, Manual of Directions, Siebrecht Attitude Scale (New York: The University, n.d.).

Amos E. Neyhart, Director Emeritus and Consultant to the Institute of Public Safety, Pennsylvania State University. The exercises in the test were designed to measure and improve a driver's skill in handling a vehicle. The test consists of the following six exercises: (1) driving in a straight line, (2) steering in close limits, (3) stopping smoothly from 20 mph, (4) determining front and rear limits, (5) parallel parking, and (6) measuring reaction and braking distance. A competent judge administers the test to each student and assigns a letter grade for each exercise. The letter grades are converted to an interval scale and summed to obtain an overall score for the test. The six areas are considered to be of equal value in determining the performance skill of a student.

Although the knowledge and skill tests selected have no stated reliability or validity, they are both standardized tests and were selected over tests with stated reliability and validity. For this reason, it was assumed that the tests could be scored with a relatively high degree of objectivity.

III. THE SAMPLE

The sample for this study consisted of the students enrolled in the driver education program for the spring semester 1969 at the following secondary schools in the El Paso, Texas, Public School System: (1) Austin, (2) Bowie, (3) Coronado, (4) El Paso High, (5) El Paso Technical, (6) Irvin, and (7) Jefferson. The students from Irvin High School were randomly assigned to instructional treatment by drawing names from a hat and being assigned alternately to treatments

I and II. The students from Austin and Coronado high schools were assigned to treatment I until the limit for the class had been met, and the remainder received treatment II. There were no established criteria for the assignments. Students were assigned as they registered for the course. Due to the scheduling of the simulator and limited enrollment, there was no possibility for both treatments to be applied at El Paso High, El Paso Technical, Jefferson High, or Bowie High. The initial sample consisted of 400 students from all seven schools. Due to absences on days the tests were administered and incomplete data in the cumulative folders, 131 samples were discarded. The number of students from each school and the treatments they received are listed in Table I.

The nonrandom selection of the students to participate in the study presents a problem as to the limit of generalization. Generalizations of the findings of the study cannot be made to the student population as a whole, but it is felt that students who elect to take the driver education program will be similar in characteristics to the population under study at the present time and therefore inferences will be directed to this population only.

IV. DATA COLLECTION

Class rolls were obtained from each of the driver education instructors in the seven schools. From these lists, it was possible to go to the student personnel files and obtain the necessary background information. This consisted of each student's score on the

TABLE I

SAMPLE SIZE AND TREATMENT ASSIGNMENT BY SCHOOL

School	Sample Size	
	Treatment I	Treatment II
Austin	23	66
Bowie	0	23
Coronado	23	31
El Paso High	21	0
El Paso Technical	19	0
Irvin	23	21
Jefferson	0	19
Total	109	160

Iowa Test of Educational Development and information regarding the parents' occupations to be used in determining the socioeconomic status of the student.

Ethnic membership of the student was determined by using the responses to four separate questions (see Appendix A) regarding the respondent's name, ancestry (Spanish- or Mexican-American, or Anglo), language used in various social situations, and parents' birthplaces. If a student indicated he was of Spanish- or Mexican-American descent, his surname was compared to those generally judged as indicative of that heritage. As a final check, the instructor gave his opinion based on physical characteristics. This method of identification parallels that used by the United States Bureau of the Census.[10]

The socioeconomic status of the samples was determined by consultation with the school counselors. With the use of the counselors' records and personal knowledge, students were classified as either disadvantaged or not disadvantaged. The criterion for disadvantaged classification was that the student be from a family whose combined annual income did not exceed $3,000.[11]

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[10]United States Bureau of the Census, U.S. Census of Population: 1960. Subjects' Reports, Persons of Spanish Surnames. Final Report PC(2)-1B (Washington: Government Printing Office, 1963), pp. vi-xii.

[11]John F. Hughes (director), Title I Program Guide No. 36, Division of Compensatory Education, United States Department of Health, Education and Welfare (Washington: Government Printing Office, 1968), p. 2.

Each student was posttested with the appropriate instrument for measuring knowledge, attitudes, and skills relevant to the driving task. The tests were hand scored; correlated with background information for each student which included identification as to sex, ethnicity, socioeconomic status, and the composite score on the Iowa Test of Educational Development; and then keypunched for computer analysis.

V. HYPOTHESES TO BE TESTED

In the course of this investigation, the following specific hypotheses were tested:

1. There is no significant difference in mean scores for post-course driver education performances, as measured by knowledge, attitude, and skill scores, between students taught by a simulator centered course and students taught by a dual-control car centered course after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.
2. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between Mexican-American and Anglo-American students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.

3. There are no significant differences in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between male and female students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.
4. There are no significant differences in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between nondisadvantaged and disadvantaged students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.
5. There are no significant first-order interactions between method of instruction and sex, ethnicity, and/or socioeconomic status with respect to driving knowledge, attitude, and skill mean scores.
6. There are no significant first-order interactions among all possible combinations of sex, ethnicity, and socioeconomic status with respect to driving knowledge, attitude, and skill mean scores.

VI. STATISTICAL TREATMENT OF THE DATA

A multiple classification analysis of covariance was used to test the hypotheses of no significant differences between the means

of the criterion measures of performance achievement in driver education for treatment factors and the classification factors of ethnicity, sex, and socioeconomic status. The classification factors are the experimental units into classes which are homogeneous with respect to what is being classified. In contrast, treatment factors define the experimental conditions applied to an experimental unit. The effects of the treatment factors are of primary interest, whereas classification factors are included to reduce the experimental error, clarify interpretations of the effects of the treatment factors, and determine effects of treatment and classification factor interactions. The variables used in the analysis are defined as follows:

Independent--Treatment, ethnic identity, sex, and socioeconomic status

Dependent or Criterion--Knowledge scores--As measured by National Test in Driver Education

Attitude scores --As measured by Siebrecht Attitude Scale

Skill scores --As measured by Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles

Control--Composite achievement score on Iowa Test of Educational Development

By utilizing the analysis of covariance, the usual tests can be made for group differences between the independent or main-effect variables, as well as for significant interactions between them, just as if an analysis of variance was being made. In addition, the researcher can statistically equate the independent variables with respect to one or more variables which are relevant to the dependent variable.[12]

The students' composite score on the Iowa Test of Educational Development was used as the control variable. It was logical to assume that there would be variability within the sample population considering achievement levels and intellectual ability. Normally, a measure of the students' IQ is used in studies of this nature; however, this information was not readily available for this study. The Iowa Test of Educational Development, however, was administered throughout the El Paso Public School System for all ninth grade students. With the exception of transfer students, this information was available for each student included in the sample. When utilizing a covariate, it is not necessary for it to be measured on the same scale as the dependent variable, nor does it need to be a direct causal agent of the dependent variable. It may merely reflect some characteristic of the environment that also influences the criterion.[13]

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[12]James W. Popham, Educational Statistics: Use and Interpretation (New York: Harper and Row, 1967), p. 223.

[13]William G. Cochran, "Analysis of Covariance: Its Nature and Uses," Biometrics, 13(3):263-64, September, 1957.

The mathematical model used in the analysis of the data was a 2 x 2 x 2 x 2 factorial, completely random model, as follows:

$$Y_{ijk\ell m} = \mu + T_i + E_j + S_k + D_\ell + (TE)_{ij} + (TS)_{ik} + (TD)_{i\ell} + (ES)_{jk} + (ED)_{j\ell} + (SD)_{k\ell} + (TES)_{ijk} + (TED)_{ij\ell} + (TSD)_{ik\ell} + (ESD)_{jk\ell} + \varepsilon_{ijk\ell} + \beta(X_{ijk\ell m} - \bar{X}) + e_{ijk\ell m}$$

where

μ = population mean

T_i = effect due to instructional method

E_j = effect due to ethnicity

S_k = effect due to sex

D_ℓ = effect due to socioeconomic status (SES)

$(TE)_{ij}$ = method x ethnicity interaction

$(TS)_{ik}$ = method x sex interaction

$(TD)_{i\ell}$ = method x SES interaction

$(ES)_{jk}$ = ethnicity x sex interaction

$(ED)_{j\ell}$ = ethnicity x SES interaction

$(SD)_{k\ell}$ = sex x SES interaction

$(TES)_{ijk}$ = method x ethnicity x sex interaction

$(TED)_{ij\ell}$ = method x ethnicity x SES interaction

$(TSD)_{ik\ell}$ = method x sex x SES interaction

$(ESD)_{jk\ell}$ = ethnicity x sex x SES interaction

$\varepsilon_{ijk\ell}$ = all third order interactions. These will be assumed to equal 0 and all numerical values will be due to random

variations and a measure of experimental error.

$\beta(X_{ijk\ell m} - \bar{X})$ = regression coefficient

$e_{ijk\ell m}$ = sampling error

$i = 1,2$	1 = dual control method	2 = simulator method
$j = 1,2$	1 = Anglo	2 = Mexican-American
$k = 1,2$	1 = male	2 = female
$\ell = 1,2$	1 = disadvantaged	2 = nondisadvantaged

The variable $X_{ijk\ell m}$ represents the score on the Iowa Test of Educational Development (ITED) which was used for the covariate. In the term $\beta(X_{ijk\ell m} - \bar{X})$, $\bar{X}$ = arithmetic mean of $X_{ijk\ell m}$ and β = partial regression of dependent variable (y) on the covariate (x).

Statistical analyses were made of the data using Harvey's least square analysis of covariance for unequal subclass numbers.[14] Duncan's new multiple range test[15] was used to compare multiple treatment means whenever significance was found. The probability level for accepting or rejecting the null hypotheses was 0.05. The CDC 3300 computer was used for the analysis utilizing a statistical package available from the Statistical Laboratory, College of Agriculture, New Mexico State University.

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[14]Walter R. Harvey, Least-Squares Analysis of Data with Unequal Subclass Numbers, United States Department of Agriculture, ARS 20-8 (Beltsville, Maryland: Agricultural Research Service, 1960).

[15]Robert Steel and James Torrie, Principles and Procedures of Statistics (New York: McGraw-Hill Book Company, Inc., 1960), pp. 107-8.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF THE DATA

The purpose of this chapter is to present and interpret the results of the statistical treatments applied to the data. The requisite assumptions for applying the analysis of covariance and the methods and results of testing the validity of these assumptions are discussed in the first section. The results obtained in the analysis in relation to each hypothesis tested are discussed in section two.

I. TESTING OF ASSUMPTIONS

The analysis of covariance was used in this study primarily to adjust treatment means of the dependent variables for initial differences in subjects' performance that would otherwise adversely affect the interpretation of the statistical findings. The covariance adjustment has the effect of decreasing the experimental error, statistically rather than experimentally, and consequently increases the precision of the experiment. For example, in this study, if scores on the control variable were correlated with scores on the dependent variable, knowledge, a portion of the experimental error for knowledge could be the result of differences in the Iowa Test of Educational Development (ITED) scores. By use of the covariance analysis, the contribution to the experimental error for each of the dependent variables by the differences in ITED scores was computed and eliminated from the experimental error for each of these variables.

A first step in the analysis was to run a correlation between the control variable, the composite score on the ITED, and the three criterion variables, knowledge, attitude, and skills. By computing a product-moment correlation coefficient, the magnitude and direction of the relationship between the control variables and each of the criterion variables was ascertained. The product-moment coefficient (r) was computed by the following formula:[1]

$$r = \frac{\Sigma xy}{\sqrt{(\Sigma x^2)\ (\Sigma y^2)}}$$

where

x = deviation of control variable score from its mean

y = deviation of corresponding criterion variable from its mean

The results of the computations for this study are as follows:

Criterion	Correlation Coefficient
Knowledge	0.54*
Attitude	0.47*
Skill	0.15*

*df = 267 r at 0.05 = 0.14

An examination of Figures 1, 2, and 3 shows graphically that there is indeed a relationship, positive in nature, and the relationship appears to be linear.

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[1]James W. Popham, Educational Statistics: Use and Interpretation (New York: Harper and Row, 1967), p. 70.

ITED SCORES

KNOWLEDGE SCORES

	0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23	24-26	27-30
54-56										
51-53										
48-50										
45-47										
42-44										
39-41										
36-38										
33-35										
30-32										
27-29										
24-26										

FIGURE 1

FREQUENCY TABLE: KNOWLEDGE VS. ITED

ITED SCORES

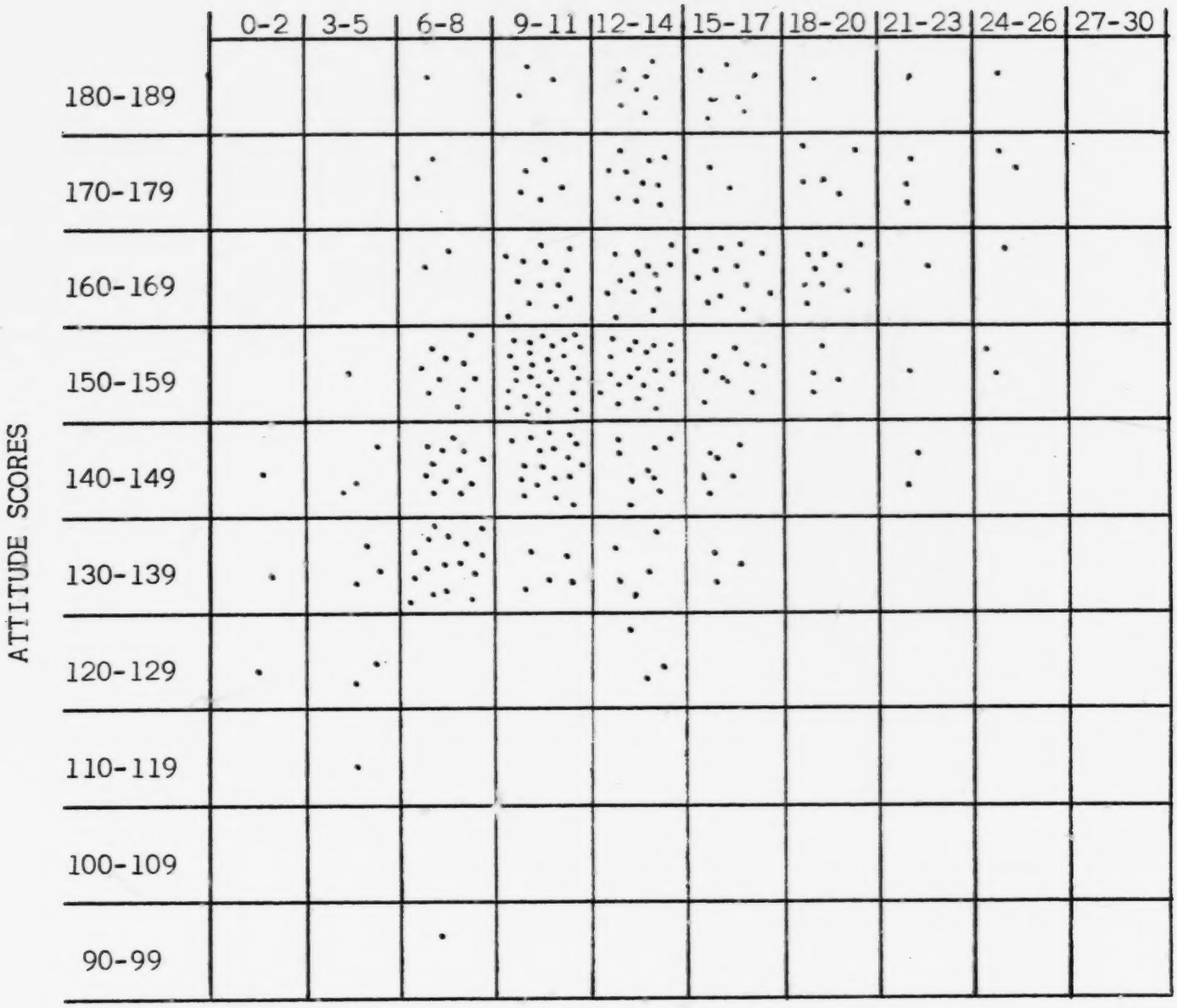

FIGURE 2

FREQUENCY TABLE: ATTITUDE VS. ITED

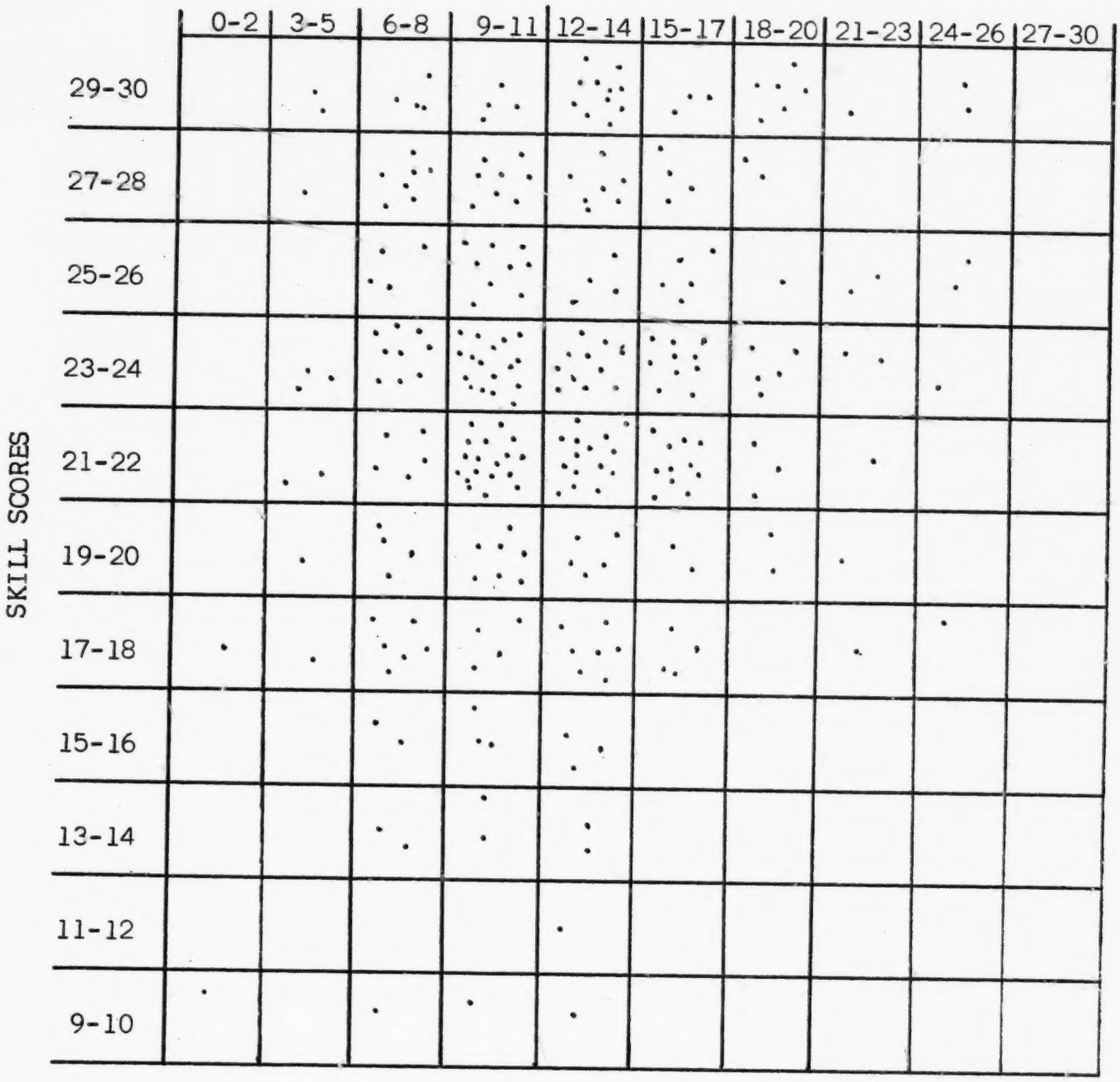

FIGURE 3

FREQUENCY TABLE: SKILL VS. ITED

Combining the results of the computation of r which quantifiably provides a measure of the strength and direction of the relationship and of the visual relationship shown in Figures 1, 2, and 3, it is concluded that the ITED score is correlated with each of the criterion variables at the 0.05 level of probability and is justifiable for use as a covariate.

The analysis of covariance, being a combination of linear regression and analysis of variance techniques, must satisfy assumptions applicable to each. Denoting the covariate as X and the dependent or criterion variable as Y, the following assumptions are necessary for the valid use of covariance:[2]

1. The X's are fixed and measured without error.
2. The regression of Y on X is linear and independent of treatments.
3. The residuals are normally and independently distributed with zero mean and common variance.

Assumption one implies that there should not be any systematic variation in X across treatment groups. Meyers pointed out that "if X is an integral part of the treatment, adjustment for variation in X should not be undertaken."[3] Steel and Torrie, on the other hand, stated that ". . . in situations where real differences among treatments for the control variable do occur but are not the direct

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[2]Robert Steel and James Torrie, Principles and Procedures of Statistics (New York: McGraw-Hill Book Company, Inc., 1960), p. 309.

[3]Jerome L. Meyers, Fundamentals of Experimental Design (Boston: Allyn and Bacon, 1966), p. 323.

effect of the treatments, adjustment is warranted."[4] For this study, the covariate was not affected by the treatments, as the measure of the covariate was taken before the treatments were applied. An analysis of variance was run on the covariate to determine if real differences did exist. The results of this analysis are summarized in Table II. Significant differences were noted only for the classification of ethnicity. This difference was to be expected. As stated previously in Chapter II, according to Grebler, an educational gap does exist between Anglo-Americans and Mexican-Americans, especially at the high school level.[5] The mean scores on the covariate for each of the ethnic groups bear out this fact. These are: Mexican-Americans, 10.64; Anglo-Americans, 14.22.

Assumption two states that a common regression coefficient β can be used for the entire experiment. This implies that the regression coefficients for each treatment breakdown are relatively homogeneous. The method proposed by Steel and Torrie was used to test the homogeneity of regression.[6] Table III summarizes the results of this test. This assumption proved tenable for all treatment breakdowns with the exception of the main effect sex

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[4]Steel and Torrie, op. cit., p. 308.

[5]Leo Grebler, The Schooling Gap: Signs of Progress (Advance Report No. 7 of the Mexican-American Study Project, Graduate School of Business Administration, University of California, Los Angeles, 1967).

[6]Steel and Torrie, op. cit., p. 319.

TABLE II

ANALYSIS OF VARIANCE FOR DIFFERENCES AMONG TREATMENTS ON THE COVARIATE: ITED SCORE

Source of Variation	Degrees of Freedom	Mean Squares	"F" Ratio
Treatment	1	15.813	<1
Ethnicity	1	101.507	5.84*
Sex	1	10.127	<1
Socioeconomic Status	1	1.047	<1
Error	254	17.377	

*df = 1/254 "F" at 0.05 = 3.88 "F" at 0.01 = 6.74

TABLE III

"F" RATIOS FOR HOMOGENEITY OF REGRESSION TEST

Source of Variation	Dependent Variables			Degrees of Freedom	Rejection Level	
	Knowledge	Attitude	Skill		α=0.05	α=0.01
Treatment	<1	<1	<1	1 265	3.84	6.63
Ethnicity	<1	3.16	<1	1 265	3.84	6.63
Sex	<1	<1	6.11	1 265	3.84	6.63
Socioeconomic Status	<1	<1	<1	1 265	3.84	6.63
Treatment by Ethnicity	1.48	1.60	<1	3 261	2.60	3.78
Treatment by Sex	<1	<1	3.17	3 261	2.60	3.78
Treatment by Socioeconomic Status	<1	<1	<1	3 261	2.60	3.78
Ethnicity by Sex	<1	1.26	1.21	3 261	2.60	3.78
Ethnicity by Socioeconomic Status	<1	1.22	1.68	3 261	2.60	3.78
Sex by Socioeconomic Status	<1	<1	3.17	3 261	2.60	3.78
Treatment by Ethnicity by Sex	<1	<1	1.00	7 255	2.01	2.64
Treatment by Ethnicity by Socioeconomic Status	1.36	1.00	<1	7 255	2.01	2.64
Treatment by Sex by Socioeconomic Status	<1	<1	1.17	7 255	2.01	2.64
Ethnicity by Sex by Socioeconomic Status	<1	<1	<1	7 255	2.01	2.64

and first-order interactions for treatment by sex and sex by socioeconomic status only for the dependent variable skill. The hypothesis of homogeneity of regression coefficients was rejected at the 0.05 level but could be accepted at $\alpha = 0.01$. As shown previously, the control variable correlated least with the dependent variable skill. As a result of the previous test, the test for significant differences for the classifications sex, treatment by sex, and sex by socioeconomic status interactions will be made on the unadjusted means.

Assumption three refers to the usual assumptions associated with the analysis of variance. The assumption of normality can be satisfied by observing Figures 4, 5, and 6. Although the distributions are not perfectly bell-shaped as a normal distribution should be, they are reasonably symmetric and are accepted as such.

The assumption of equal variances was tested by means of Hartley's Maximum-F test.[7] The results of this test are summarized in Table IV. No significant differences were found for the criterion variables knowledge and attitude nor for the main effects of the skill variable. Significant differences were found for all first and second-order interactions for the criterion variable skill with the following exceptions: ethnicity by sex, sex by socioeconomic status, and ethnicity by sex by socioeconomic status. Each of the interactions that showed significance was observed to

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[7]H. C. Fryer, Concepts and Methods of Experimental Statistics (Boston: Allyn and Bacon, Inc., 1966), pp. 246-47.

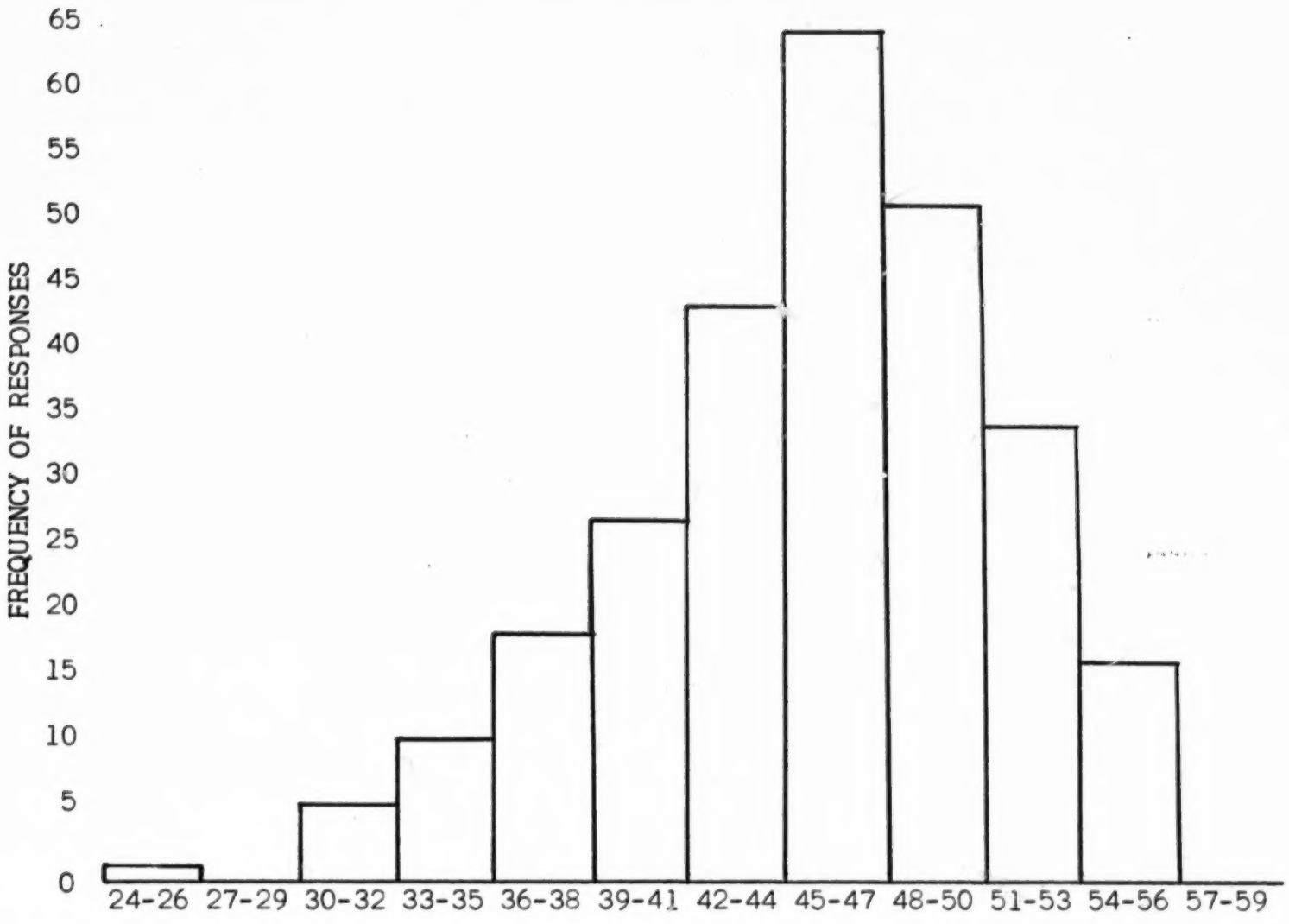

FIGURE 4

FREQUENCY CHART OF KNOWLEDGE SCORES

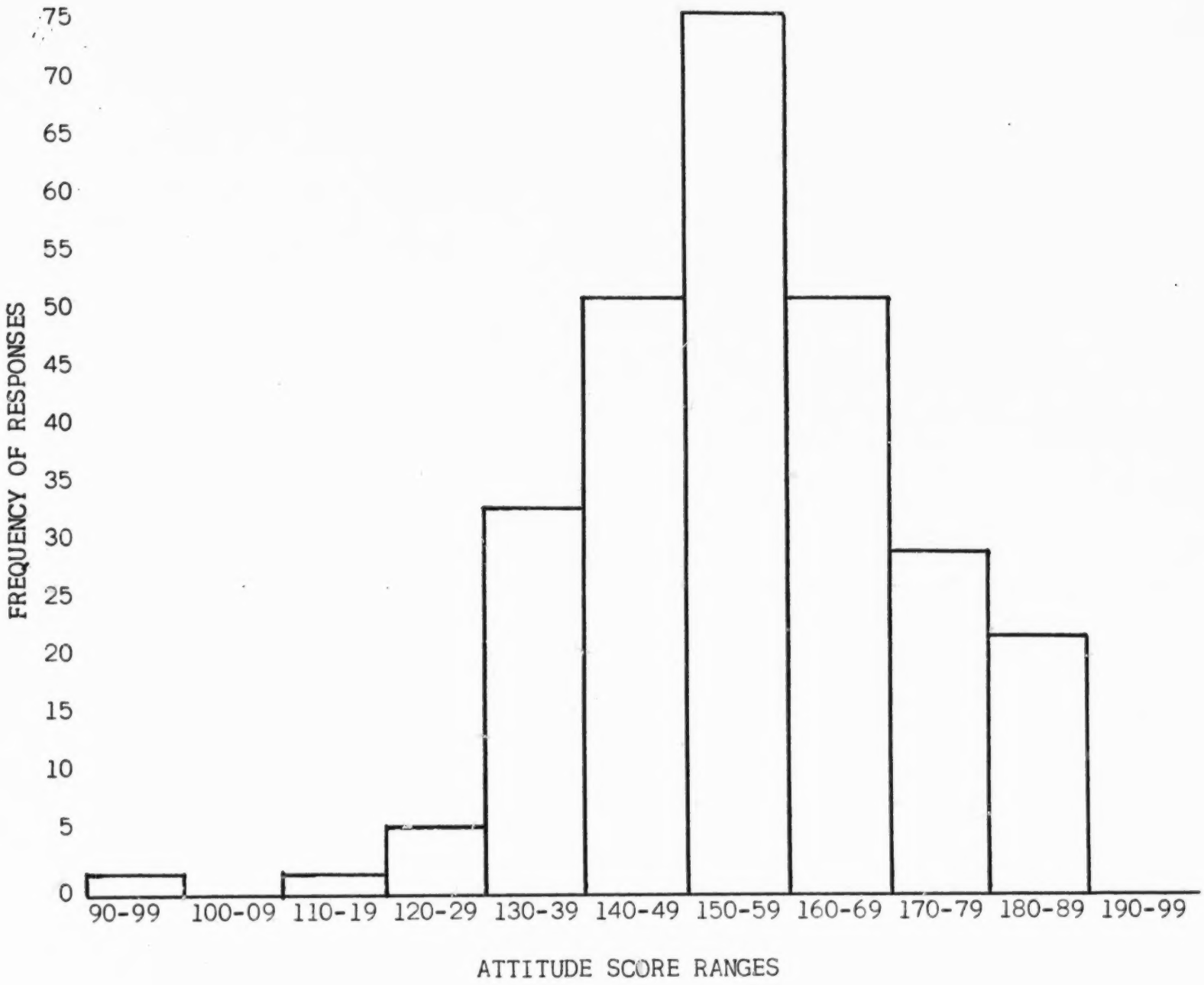

FIGURE 5

FREQUENCY CHART OF ATTITUDE SCORES

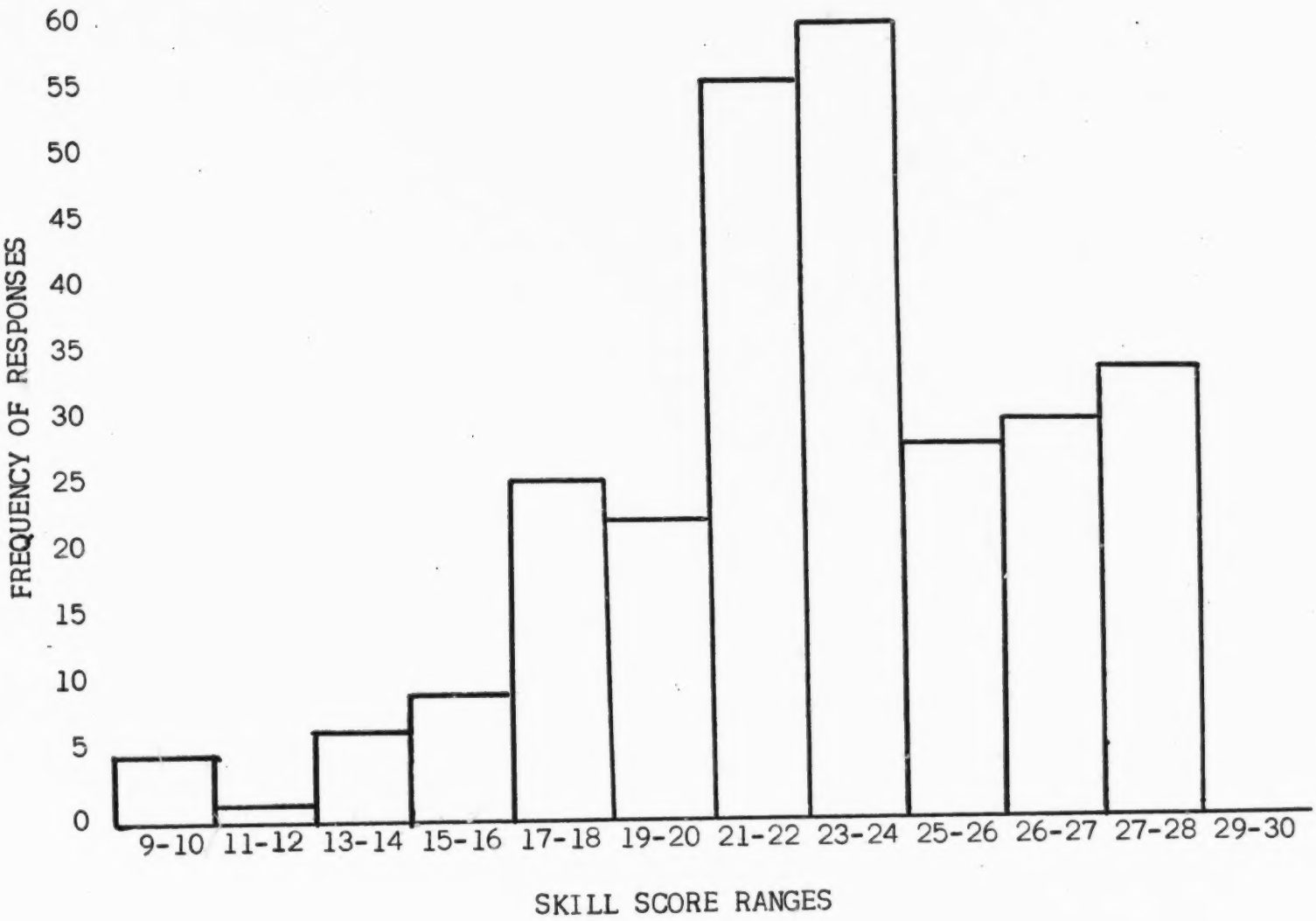

FIGURE 6

FREQUENCY CHART OF SKILL SCORES

TABLE IV

SIGNIFICANT "F" VALUES FOR HOMOGENEITY OF VARIANCE TEST USING HARTLEY'S MAXIMUM "F" TEST[a]

Source of Variation	Variable: Knowledge	Attitude	Skill	k	v	α=.05	α=.01
Treatment	1.27	1.08	1.59	2	135	1.65	1.95
Ethnicity	1.01	1.13	1.21	2	135	1.65	1.95
Sex	1.27	1.02	1.49	2	135	1.65	1.95
Socioeconomic Status	1.14	1.20	1.03	2	135	1.65	1.95
Treatment by Ethnicity	1.50	1.46	2.44	4	67	1.95	2.20
Treatment by Sex	1.67	1.20	2.11	4	67	1.95	2.20
Treatment by Socioeconomic Status	1.37	1.65	2.58	4	67	1.95	2.20
Ethnicity by Sex	1.29	1.21	1.66	4	67	1.95	2.20
Ethnicity by Socioeconomic Status	1.60	1.24	2.91	4	67	1.95	2.20
Sex by Socioeconomic Status	1.57	1.20	1.84	4	67	1.95	2.20
Treatment by Ethnicity by Sex	1.89	1.64	4.50	8	34	3.00	3.63
Treatment by Ethnicity by Socioeconomic Status	1.87	2.07	4.51	8	34	3.00	3.63
Treatment by Sex by Socioeconomic Status	2.20	1.91	3.93	8	34	3.00	3.63
Ethnicity by Sex by Socioeconomic Status	1.72	1.25	2.82	8	34	3.00	3.63

[a] F_{max} = (Largest s^2)/(Smallest s^2) for k samples from normal populations, each providing v degrees of freedom for s^2. Where the number of degrees of freedom for each sample are unequal, v = the average degrees of freedom [H. C. Fryer, Concepts and Methods of Experimental Statistics (Boston: Allyn and Bacon, Inc., 1966), p. 246].

have at least one cell in the treatment partition to be disproportionate to the other cells with regard to the number of cell entries. There is also considerable discussion among statisticians as to the necessity for all assumptions to be rigorously met in the analysis of variance models. With regard to the usual tests for homogeneity of error variance, Box said, "To make the preliminary tests on variances is rather like putting to sea in a rowing boat to find out whether conditions are sufficiently calm for an ocean liner to leave port."[8] The work of Box has shown that the distribution of the "F" ratio in the analysis of variance is affected very little by inequalities in the variances which are pooled into the experimental error.

II. DISCUSSION WITH REGARD TO HYPOTHESES TESTED

Based on the assumption that an analysis of covariance was the appropriate statistical technique for this study and due to unequal samples in the treatments, Harvey's least squares analysis of covariance for unequal subclass numbers was used in the analysis.[9] This technique computes unbiased estimates of sums of squares that would have occurred had the sample sizes been equal.

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[8]G. E. P. Box, "Non-Normality and Tests on Variance," Biometrika, 40:333, 1953.

[9]Walter R. Harvey, Least-Squares Analysis of Data with Unequal Subclass Numbers, United States Department of Agriculture, ARS 20-8, (Beltsville, Maryland: Agricultural Research Service, 1960).

Before making the analysis of covariance, a straight analysis of variance was made to determine the effects of the covariance adjustment. The results of this analysis are summarized in Tables V, VI, and VII. No significant differences were found for any treatment effects or interactions for the criterion variables knowledge or skill. Significant differences at the 0.05 level were observed for the criterion variable attitude for the main effect ethnicity and first-order interactions treatment by ethnicity and treatment by socioeconomic status. No interpretations were made until after the covariance adjustment.

As was stated previously, for the criterion variable skill, differences due to sex, treatment by sex, and sex by socioeconomic status would be analyzed on the unadjusted means due to the heterogeneity of regression coefficients and the marginal use of the ITED score as a covariate. For these classifications, no significant differences were noted. Therefore, the null hypotheses of no significant differences between the means of the skill scores for male and female students are accepted at the 0.05 level of probability. The null hypotheses of no significant interactions for treatment by sex and sex by socioeconomic status are accepted at the 0.05 level of probability.

TABLE V

ANALYSIS OF VARIANCE ON VARIABLE NO. 1 - KNOWLEDGE

Source of Variation	Degrees of Freedom	Mean Squares	"F" Ratio
Treatments	1	6.725	<1
Ethnicity	1	86.301	2.90
Sex	1	7.981	<1
Socioeconomic Status	1	13.965	<1
Treatment by Ethnicity	1	30.488	1.02
Treatment by Sex	1	33.376	1.12
Treatment by Socioeconomic Status	1	0.876	<1
Ethnicity by Sex	1	6.554	<1
Ethnicity by Socioeconomic Status	1	12.642	<1
Sex by Socioeconomic Status	1	0.394	<1
Treatment by Ethnicity by Sex	1	12.476	<1
Treatment by Ethnicity by Socioeconomic Status	1	0.360	<1
Treatment by Sex by Socioeconomic Status	1	17.282	<1
Ethnicity by Sex by Socioeconomic Status	1	66.584	2.24
Error	254	29.777	

df = 1/254 "F" at 0.05 = 3.88

TABLE VI

ANALYSIS OF VARIANCE ON VARIABLE NO. 2 - ATTITUDE

Source of Variation	Degrees of Freedom	Mean Squares	"F" Ratio
Treatments	1	730.924	3.23
Ethnicity	1	1333.186	5.89*
Sex	1	298.800	1.32
Socioeconomic Status	1	240.936	1.06
Treatment by Ethnicity	1	1064.881	4.71*
Treatment by Sex	1	516.125	2.28
Treatment by Socioeconomic Status	1	919.981	4.07*
Ethnicity by Sex	1	42.887	<1
Ethnicity by Socioeconomic Status	1	157.669	<1
Sex by Socioeconomic Status	1	66.533	<1
Treatment by Ethnicity by Sex	1	78.781	<1
Treatment by Ethnicity by Socioeconomic Status	1	341.820	1.51
Treatment by Sex by Socioeconomic Status	1	142.914	<1
Ethnicity by Sex by Socioeconomic Status	1	140.911	<1
Error	254	226.310	

*df = 1/254 "F" at 0.05 = 3.88 "F" at 0.01 = 6.74

TABLE VII

ANALYSIS OF VARIANCE ON VARIABLE NO. 3 - SKILL

Source of Variation	Degrees of Freedom	Mean Squares	"F" Ratio
Treatments	1	16.588	<1
Ethnicity	1	2.873	<1
Sex	1	31.255	1.71
Socioeconomic Status	1	1.588	<1
Treatment by Ethnicity	1	1.106	<1
Treatment by Sex	1	0.085	<1
Treatment by Socioeconomic Status	1	5.972	<1
Ethnicity by Sex	1	22.627	1.24
Ethnicity by Socioeconomic Status	1	0.172	<1
Sex by Socioeconomic Status	1	0.011	<1
Treatment by Ethnicity by Sex	1	12.229	<1
Treatment by Ethnicity by Socioeconomic Status	1	2.738	<1
Treatment by Sex by Socioeconomic Status	1	0.423	<1
Ethnicity by Sex by Socioeconomic Status	1	2.132	<1
Error	254	18.270	

df = 1/254 "F" at 0.05 = 3.88

The results of the analysis of covariance are summarized in Tables VIII, IX, and X. The significant "F" value obtained for the regression on ITED reemphasizes the validity of the ITED score used as the covariate. When comparing the analysis of variance error mean square with the analysis of covariance error mean square, it is readily apparent that one objective of the covariance approach has been reached, i.e., reducing the error variance and thereby increasing the precision of the experiment.

The significant difference in attitudes between Mexican-American and Anglo students disappeared after the covariate adjustment. This indicates that most of the observable variation in attitudes could be attributed to variation in the mean ITED scores for the two ethnic groups. The significant difference in attitudes for the treatment by ethnicity interaction was also eliminated after the covariance adjustment.

However, the significant difference observed for attitudes in the treatment by socioeconomic status interaction while lowered somewhat, remained significant at the 0.05 level after the covariate adjustment. This indicates that the factors treatment and socioeconomic status are not independent of one another. Either the treatment effect is not the same for each level of socioeconomic status or the socioeconomic status effect is not the same for each level of treatment. A look at the adjusted means (Table XVI, Appendix C) will shed additional light on the nature of the differences. Kramer's adaptation of Duncan's New Multiple Range Test for unequal sample

TABLE VIII

ANALYSIS OF COVARIANCE ON VARIABLE NO. 1 – KNOWLEDGE UTILIZING THE ITED COMPOSITE SCORE AS A COVARIATE

Source of Variation	Degrees of Freedom	Mean Squares	"F" Ratio
Treatment	1	0.018	<1
Ethnicity	1	5.538	<1
Sex	1	25.019	1.15
Socioeconomic Status	1	19.697	<1
Treatment by Ethnicity	1	3.849	<1
Treatment by Sex	1	12.834	<1
Treatment by Socioeconomic Status	1	0.264	<1
Ethnicity by Sex	1	16.236	<1
Ethnicity by Socioeconomic Status	1	14.414	<1
Sex by Socioeconomic Status	1	0.274	<1
Treatment by Ethnicity by Sex	1	0.025	<1
Treatment by Ethnicity by Socioeconomic Status	1	0.768	<1
Treatment by Sex by Socioeconomic Status	1	28.124	1.30
Ethnicity by Sex by Socioeconomic Status	1	55.547	2.56
Regression on ITED	1	2076.021	95.72**
Error	253	21.689	

**df = 1/253 "F" at 0.05 = 3.88 "F" at 0.01 = 6.74

TABLE IX

ANALYSIS OF COVARIANCE ON VARIABLE NO. 2 - ATTITUDE UTILIZING THE ITED COMPOSITE SCORE AS A COVARIATE

Source of Variation	Degrees of Freedom	Mean Squares	"F" Ratio
Treatments	1	440.371	2.35
Ethnicity	1	442.574	2.36
Sex	1	487.198	2.60
Socioeconomic Status	1	291.294	1.56
Treatment by Ethnicity	1	611.184	3.26
Treatment by Sex	1	319.259	1.70
Treatment by Socioeconomic Status	1	735.505	3.93*
Ethnicity by Sex	1	95.808	<1
Ethnicity by Socioeconomic Status	1	171.287	<1
Sex by Socioeconomic Status	1	31.558	<1
Treatment by Ethnicity by Sex	1	264.770	1.41
Treatment by Ethnicity by Socioeconomic Status	1	231.737	1.24
Treatment by Sex by Socioeconomic Status	1	88.756	<1
Ethnicity by Sex by Socioeconomic Status	1	106.349	<1
Regression on ITED	1	10092.497	53.88**
Error	253	187.313	

*df = 1/253 "F" at 0.05 = 3.88

**df = 1/253 "F" at 0.01 = 6.74

TABLE X

ANALYSIS OF COVARIANCE ON VARIABLE NO. 3 - SKILL UTILIZING THE ITED COMPOSITE SCORE AS A COVARIATE

Source of Variation	Degrees of Freedom	Mean Squares	"F" Ratio
Treatments	1	21.230	1.18
Ethnicity	1	0.010	<1
Sex	1	26.524	1.47
Socioeconomic Status	1	1.255	<1
Treatment by Ethnicity	1	3.077	<1
Treatment by Sex	1	0.529	<1
Treatment by Socioeconomic Status	1	7.459	<1
Ethnicity by Sex	1	25.473	1.41
Ethnicity by Socioeconomic Status	1	13.439	<1
Sex by Socioeconomic Status	1	0.016	<1
Treatment by Ethnicity by Sex	1	17.285	<1
Treatment by Ethnicity by Socioeconomic Status	1	3.795	<1
Treatment by Sex by Socioeconomic Status	1	0.772	<1
Ethnicity by Sex by Socioeconomic Status	1	1.740	<1
Regression on ITED	1	82.311	4.57*
Error	253	18.017	

*df = 1/253 "F" at 0.05 = 3.88 "F" at 0.01 = 6.74

sizes was run to make the comparison of nonindependent means.[10] The results of this analysis are summarized in Table XI. There are no significant differences indicated between the mean scores of treatment one by nondisadvantaged, treatment two by disadvantaged, or treatment two by nondisadvantaged. The mean score of the classification treatment one by disadvantaged was significantly different from each of the other three means. This indicates that the particular combination of traditional treatment with the classification of disadvantaged students results in mean scores significantly different from other classifications in the treatment by socioeconomic subpopulation. As mentioned in Chapter III, the standard score from a group of traffic experts was 173 points on the attitude scale. It is interesting to note that the mean score that was causing the significant differences was closest to this standard score.

Specific hypotheses to be tested were stated in the null form to facilitate the statistical procedures to be used. The results of each hypothesis tested are as follows:

Hypothesis 1. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between students taught by a simulator centered course and students taught by a dual

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[10]H. C. Fryer, Concepts and Methods of Experimental Statistics (Boston: Allyn and Bacon, Inc., 1966), pp. 274-75.

TABLE XI

INDIVIDUAL COMPARISON OF TREATMENT BY SOCIOECONOMIC STATUS MEANS FOR ATTITUDE SCORES, USING DUNCAN'S MODIFIED MULTIPLE RANGE TEST

Means:

Treatment 1 by Disadvantaged	Treatment 1 by Nondisadvantaged	Treatment 2 by Disadvantaged	Treatment 2 by Nondisadvantaged
169.37 n = 24	154.31 n = 85	154.32 n = 37	156.34 n = 123

$s^2 = 187.31$ df = 253

	P =	2	3	4
Significant Studentized Ranges (SSR)		2.92	3.07	3.15

	1	2	3	4
Ranked Means	154.31	154.32	156.34	169.37

Least Significant Range = $(S'\bar{x})(SSR)$

$$S'\bar{x} = \sqrt{\left(\frac{1}{2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)s^2}$$

LSR		Actual	
4-1	= 7.02	4-1	= 15.06
4-2	= 7.80	4-2	= 15.05
3-1	= 4.18	3-1	= 2.03
2-1	= 5.55	2-1	= 0.01
3-2	= 5.29	3-2	= 2.02
4-3	= 6.31	4-3	= 13.03

154.31	154.32	156.34	169.37

[a]Any two means not underscored by the same line are significantly different. Any two means underscored by the same line are not significantly different.

control car centered course after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.

The results of the analysis of covariance indicate that no significant differences exist between the means of the performance scores for the two instructional methods based on the data at hand. The null hypothesis was accepted at the 0.05 level.

Hypothesis 2. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between Mexican-American and Anglo-American students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.

The results of the analysis of covariance indicate that no significant differences exist between the means of the performance scores of Mexican-American and Anglo-American students on the criterion variables based on the data at hand. The null hypothesis was accepted at the 0.05 level.

Hypothesis 3. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between male and female students

after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.

The results of the analysis of covariance indicate that no significant differences exist between the means of the performance scores of male and female students on the criterion variables used based on the data at hand. The null hypothesis was accepted at the 0.05 level.

Hypothesis 4. There is no significant difference in mean scores for post-course driver education performance, as measured by knowledge, attitude, and skill scores, between nondisadvantaged and disadvantaged students after initial differences between the two groups have been adjusted by their composite score on the Iowa Test of Educational Development.

The results of the analysis of covariance indicate that no significant differences exist between the means of the performance scores of disadvantaged and nondisadvantaged students on the criterion variables used based on the data at hand. The null hypothesis was accepted at the 0.05 level.

Hypothesis 5. There is no significant first-order interaction between method of instruction and sex, ethnicity, and/or socioeconomic status with respect to driving knowledge, attitude, and skill mean scores.

The results of the analysis of covariance indicate that no significant first-order interactions exist for the classifications treatment by sex and treatment by ethnicity for all three criterion variables. However, a significant interaction was detected at the 0.05 level for treatment by socioeconomic status for the criterion variable, attitude. This interaction was not significant for treatment by sex and treatment by ethnicity combinations.

Hypothesis 6. There is no significant first-order interaction among all possible combinations of sex, ethnicity, and socioeconomic status with respect to driving knowledge, attitude, and skill mean scores.

The results of the analysis of covariance indicate that no significant interactions exist for any combination of sex, ethnicity, and socioeconomic status in relation to the three criterion variables based on the data at hand. The null hypothesis was accepted at the 0.05 level.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this chapter is to present a summary of the study, conclusions reached based on the findings, and recommendations for further research. Included in the summary are the purpose of the study, specific questions to be answered, the procedures used in the analysis, and a synopsis of the findings.

I. SUMMARY

The major purpose of this study was to determine the relative effectiveness of a simulator centered teaching technique and a dual-control car centered teaching technique used in the laboratory phase of driver education programs as measured by knowledge, attitude, and skill scores. Ethnicity, sex, and socioeconomic status were considered as additional contributing sources of variation.

In order to evaluate the two teaching methods, the following specific questions had to be answered:

1. Will the driving knowledge, attitudes, and skills of students taught by a simulator centered course differ significantly from the driving knowledge, attitudes, and skills of students taught by a dual-control car centered course?
2. Will the driving knowledge, attitudes, and skills of Mexican-American students differ significantly

from the driving knowledge, attitudes, and skills of Anglo-American students?

3. Will the driving knowledge, attitudes, and skills of male students differ significantly from the driving knowledge, attitudes, and skills of female students?
4. Will the driving knowledge, attitudes, and skills of nondisadvantaged students differ significantly from the driving knowledge, attitudes, and skills of disadvantaged students?
5. Will the method of instruction indicate significant first-order interactions with sex, ethnicity, and/or socioeconomic status with respect to driving knowledge, attitudes, and skills?
6. Will sex, ethnicity, and socioeconomic status, in all two-way combinations, indicate significant first-order interactions with respect to driving knowledge, attitudes, and skills?

A secondary purpose of this study involved the use of the simulator as a major teaching device, but utilized two approaches for the instruction. In order to evaluate these two approaches, the following question was to be answered:

7. Will the driving knowledge, attitudes, and skills of Mexican-American students taught by a simulator centered course in Spanish differ significantly from the driving knowledge, attitudes, and skills of

Mexican-American students taught by a simulator centered course in English?

A complication arose, however, concerning this question almost immediately after instruction began. A staff member of the Region XIX Education Service Center translated the narration accompanying the instructional films from English to Spanish and recorded it on a tape recorder. After a trial period in which different arrangements were made as to speaker placement, it was the opinion of the instructor that the quality of the equipment was such that the students were not able to fully understand the instructions. He subsequently changed to the English version. There was no alternative but to discard this phase of the study.

Data for this experiment were obtained from seven high schools in the El Paso, Texas, Public School System during the spring semester 1969. Simulator instruction was given by personnel from the Region XIX Education Service Center, El Paso, Texas. The samples for the traditional method of instruction were obtained from the regularly scheduled driver education classes at the various high schools. Complete data were obtained for 269 students, of whom 109 received instruction via the traditional method and 160 received instruction on the simulator.

Background data on each of the students included in the sample were obtained by questionnaire and personal consultation with the school counselor at each of the schools. These data were used to determine the ethnicity and sex of the student and also a dichotomous measure of his socioeconomic status. A disadvantaged student

was defined as coming from a home where the combined family income did not exceed $3,000 per year. Information regarding the ITED scores of the students was obtained from the cumulative records at each school.

Performance scores for measuring competency in driving knowledge, attitudes, and skills were obtained by administering the National Test in Driver Education for knowledge, the Siebrecht Attitude Scale for attitudes, and Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles for skill. These tests were administered at the conclusion of the treatments.

In order to analyze the data statistically, the questions to be answered were restated in hypothesis form, as was indicated in Chapter III. A multiple classification analysis of covariance was used to analyze the data. The student's composite score on the Iowa Test of Educational Development was used as the covariate in order to account for variation in performance due to individual differences that could be identified and tabulated. The use of analysis of covariance, if applicable, increases the precision of the experiment by reducing the experimental error. Criterion variables for this experiment were the scores on the knowledge, attitude, and skill tests. Independent variables were method of instruction, ethnicity, sex, and socioeconomic status.

No significant differences were found to exist between the mean performance scores on the criterion variables for any of the main effects--treatment, sex, ethnicity, or socioeconomic status.

No significant first-order interactions were found to exist for any combination of the main effect variables with the exception of the treatment by socioeconomic interaction for attitude scores only. This interaction was significant at the 0.05 level, but not at the 0.01 level. The combination of disadvantaged students taught by the traditional method was determined to be responsible for the significant difference noted.

II. CONCLUSIONS

The conclusions reached are the result of the analysis of the findings of this study and as such are limited in scope by the limitations and assumptions as stated in Chapter I. Any inferences drawn apply to the population under study and other populations with similar characteristics.

Conclusions reached on the basis of hypothesis testing are as follows:

1. Since no significant differences were found between the mean scores after adjustment for ITED scores, on the criterion variable tests of the two treatments, it is concluded that the substitution of twelve hours simulator instruction for three of the six hours of behind-the-wheel instruction is not detrimental to the driver education program. In view of the fact that a considerable financial saving can be realized utilizing the simulator approach, and that the quality of

the product is apparently maintained, school districts with similar populations should be encouraged to investigate the possibility of the simulator approach.

2. Since no significant differences were found between the mean scores after adjustment for the ITED scores on the criterion variable tests of the groups when classified by sex, ethnicity, or socioeconomic status, it is concluded that the method of instruction is equally effective for each of the classification breakdowns. It is recognized that differences do exist in performance levels of ethnic groups but when differences in achievement are controlled statistically in the analysis of the data, there is no difference in performance due to the method of instruction.

3. The existence of a significant first-order interaction on the attitude criterion test for the treatment by socioeconomic combination and the subsequent identification of the subclass of disadvantaged student taught by the traditional method as the major contributor to the significant differences indicate a more mature attitude is transferred to the disadvantaged student through a more personal contact with the instructor than by the rather impersonal simulator technique. the basis for judging the responses to be of a more

mature attitude toward safe driving practices was that this group scored some thirteen points closer to the standard score established by a group of traffic experts than the other three groups. This attitude is probably due to the utilitarianism of the vehicle as perceived by the disadvantaged student rather than as a means of pleasure.

4. Since no significant first-order interactions were observed for any of the other main effect combinations, it is concluded that no combination of the main effect variables interacts in such a manner as to produce a significant advantage or disadvantage on performance scores for any subpopulation within the combination.

III. RECOMMENDATIONS

The results of a cost study conducted in January 1969 on the El Paso Public School Driver Education Program indicated that there would be a considerable savings in per-pupil expenditure utilizing the simulator to replace part of the behind-the-wheel instruction. The results of this study imply that there is no apparent difference in the quality of instruction between the two teaching techniques, nor is there any advantage of one treatment over the other when applied to specific populations. Therefore, it is recommended that the administrators in the El Paso Public School System adopt

the simulator approach to teaching the laboratory phase of the driver education program. In so doing they will be enabled to decrease the cost of per-pupil expenditure, increase the efficiency of the operation, and be assured of maintaining quality instruction in the program.

The following recommendations for further research on driver education programs are made:

1. That further studies be made on the simulator approach to teaching the laboratory phase of the driver education program with varying ratios of simulator time to behind-the-wheel instruction time. The present ratio of 4:1 has been tested and supported but not in comparison with other ratios.
2. That further studies be made of the simulator approach with additional classifications of the student such as age, academic classification, and previous driving experience be included in the analysis to determine if interactions are masking the true effects of the treatments under study.
3. That a procedure be developed to compare the effectiveness of driver training programs in terms of accident and traffic law violation records.

4. That reliable pretest measures be developed for measuring driving skill.
5. That more reliable data be obtained to adjust for initial differences in the students which may affect their performance on the criterion variables.

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APPENDIX A

ETHNICITY QUESTIONNAIRE

DATE: _____

NAME OF SCHOOL: _____

NAME OF STUDENT: _____

GRADE CLASSIFICATION: Freshman _____ Sophomore _____ Junior _____ Senior _____

SEX: Male _____ Female _____

DESCENT: (Check One) Spanish-American _____ Negro-American _____

Anglo-American _____ Other _____ (Specify)

LANGUAGE MOST OFTEN USED - At Home: English _____ Spanish _____ Other _____ (Specify)

At School: English _____ Spanish _____ Other _____ (Specify)

With Friends: English _____ Spanish _____ Other _____ (Specify)

FATHER'S BIRTHPLACE: _____

MOTHER'S BIRTHPLACE: _____

APPENDIX B

TESTING INSTRUMENTS

Testing Instruments for:

Knowledge

"National Test in Driver Education." Center For Safety Education, Division of General Education, New York University.

Attitude

"Siebrecht Attitude Scale." Elmer B. Siebrecht. Center For Safety, School of Continuing Education and Extension Services, New York University.

Skills

"Driving Skill Exercises for Use with Passenger Cars and Commercial Vehicles." Amos E. Neyhart. Institute of Public Safety, The Pennsylvania State University.

APPENDIX C

RAW SCORE MEANS AND ADJUSTED MEANS

FOR CRITERION VARIABLES

TABLE XII

RAW SCORE MEANS AND LEAST SQUARES ESTIMATE OF ADJUSTED MEANS FOR KNOWLEDGE CRITERION

Main Effect	Mean		N
	Unadjusted	Adjusted[a]	
Treatment I	45.52	46.09	109
Treatment II	45.33	46.13	160
Anglo	46.39	46.56	121
Mexican-American	44.61	45.66	148
Male	45.27	45.33	137
Female	45.55	46.89	132
Disadvantaged	45.10	46.96	61
Nondisadvantaged	45.50	45.26	208

[a]Adjusted for covariate, composite score on ITED.

TABLE XIII

RAW SCORE MEANS AND LEAST SQUARES ESTIMATE OF ADJUSTED MEANS FOR ATTITUDE CRITERION

Main Effect	Mean		N
	Unadjusted	Adjusted[a]	
Treatment I	155.85	161.85	109
Treatment II	155.73	155.33	160
Anglo	160.53	162.64	121
Mexican-American	151.90	154.55	148
Male	152.82	155.14	137
Female	158.86	162.04	132
Disadvantaged	153.41	161.85	61
Nondisadvantaged	156.48	155.33	208

[a]Adjusted for covariate, composite score on ITED.

TABLE XIV

RAW SCORE MEANS AND LEAST SQUARES ESTIMATE OF ADJUSTED MEANS FOR SKILL CRITERION

Main Effect	Mean		N
	Unadjusted	Adjusted[a]	
Treatment I	22.48	21.94	109
Treatment II	23.28	23.36	160
Anglo	23.35	22.71	121
Mexican-American	22.63	22.59	148
Male	23.91	23.46	137
Female	21.95	21.84	132
Disadvantaged	22.77	22.44	61
Nondisadvantaged	23.00	22.86	208

[a]Adjusted for covariate, composite score on ITED.

TABLE XV

RAW SCORE MEANS AND LEAST SQUARES ESTIMATE OF ADJUSTED MEANS FOR KNOWLEDGE CRITERION

Interaction Effect	Mean		N
	Unadjusted	Adjusted[a]	
Treatment I by Anglo	47.73	46.84	44
Treatment I by Mexican-American	44.03	45.34	65
Treatment II by Anglo	45.62	46.28	77
Treatment II by Mexican-American	45.06	45.98	83
Treatment I by Male	44.20	45.00	49
Treatment I by Female	46.60	47.18	60
Treatment II by Male	45.86	45.66	88
Treatment II by Female	44.68	46.60	72
Treatment I by Disadvantaged	44.42	46.86	24
Treatment I by Nondisadvantaged	45.84	45.32	85
Treatment II by Disadvantaged	45.54	47.06	37
Treatment II by Nondisadvantaged	45.27	45.20	123
Anglo by Male	46.69	45.15	54
Anglo by Female	46.15	47.97	67
Mexican-American by Male	44.35	45.51	83
Mexican-American by Female	44.94	45.81	65
Anglo by Disadvantaged	46.86	48.14	7
Anglo by Nondisadvantaged	46.36	44.98	114
Mexican-American by Disadvantaged	44.87	45.78	54
Mexican-American by Nondisadvantaged	44.46	45.54	94
Male by Disadvantaged	46.00	46.10	39
Male by Nondisadvantaged	44.98	44.56	98
Female by Disadvantaged	43.50	47.82	22
Female by Nondisadvantaged	45.96	45.96	110

[a]Adjusted for covariate, composite score on ITED.

TABLE XVI

RAW SCORE MEANS AND LEAST SQUARES ESTIMATE OF ADJUSTED MEANS FOR ATTITUDE CRITERION

Interaction Effect	Mean		N
	Unadjusted	Adjusted[a]	
Treatment I by Anglo	163.98	169.67	44
Treatment I by Mexican-American	150.35	154.03	65
Treatment II by Anglo	158.56	155.61	77
Treatment II by Mexican-American	153.11	155.05	83
Treatment I by Male	150.63	156.85	49
Treatment I by Female	160.12	163.59	60
Treatment II by Male	154.03	153.43	88
Treatment II by Female	157.81	157.23	72
Treatment I by Disadvantaged	154.58	169.37	24
Treatment I by Nondisadvantaged	156.21	154.31	85
Treatment II by Disadvantaged	152.65	154.32	37
Treatment II by Nondisadvantaged	156.66	156.34	123
Anglo by Male	157.35	157.67	54
Anglo by Female	163.09	167.61	67
Mexican-American by Male	149.87	152.61	83
Mexican-American by Female	154.49	156.47	65
Anglo by Disadvantaged	157.71	168.41	7
Anglo by Nondisadvantaged	160.70	148.77	114
Mexican-American by Disadvantaged	152.85	163.39	54
Mexican-American by Nondisadvantaged	151.35	153.79	94
Male by Disadvantaged	154.72	159.27	39
Male by Nondisadvantaged	152.06	151.01	98
Female by Disadvantaged	151.09	164.43	22
Female by Nondisadvantaged	160.41	159.65	110

[a]Adjusted for covariate, composite score on ITED.

TABLE XVII

RAW SCORE MEANS AND LEAST SQUARES ESTIMATE OF ADJUSTED MEANS FOR SKILLS CRITERION

Interaction Effect	Mean		N
	Unadjusted	Adjusted[a]	
Treatment I by Anglo	23.09	21.73	44
Treatment I by Mexican-American	22.06	22.15	65
Treatment II by Anglo	23.49	23.15	77
Treatment II by Mexican-American	23.07	23.57	83
Treatment I by Male	23.55	22.80	49
Treatment I by Female	21.60	21.08	60
Treatment II by Male	24.11	24.10	88
Treatment II by Female	22.25	22.62	72
Treatment I by Disadvantaged	21.83	21.92	24
Treatment I by Nondisadvantaged	22.66	22.58	85
Treatment II by Disadvantaged	23.38	23.58	37
Treatment II by Nondisadvantaged	23.24	23.14	123
Anglo by Male	23.81	22.74	54
Anglo by Female	22.97	22.68	67
Mexican-American by Male	23.98	24.18	83
Mexican-American by Female	20.91	21.00	65
Anglo by Disadvantaged	23.71	22.43	7
Anglo by Nondisadvantaged	23.32	22.99	114
Mexican-American by Disadvantaged	22.65	22.45	54
Mexican-American by Nondisadvantaged	22.62	22.73	94
Male by Disadvantaged	24.03	23.23	39
Male by Nondisadvantaged	23.87	23.69	98
Female by Disadvantaged	20.54	21.65	22
Female by Nondisadvantaged	22.23	22.03	110

[a]Adjusted for covariate, composite score on ITED.